the

TOOL ENGINEER

JUNE 1958

gun drilling

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

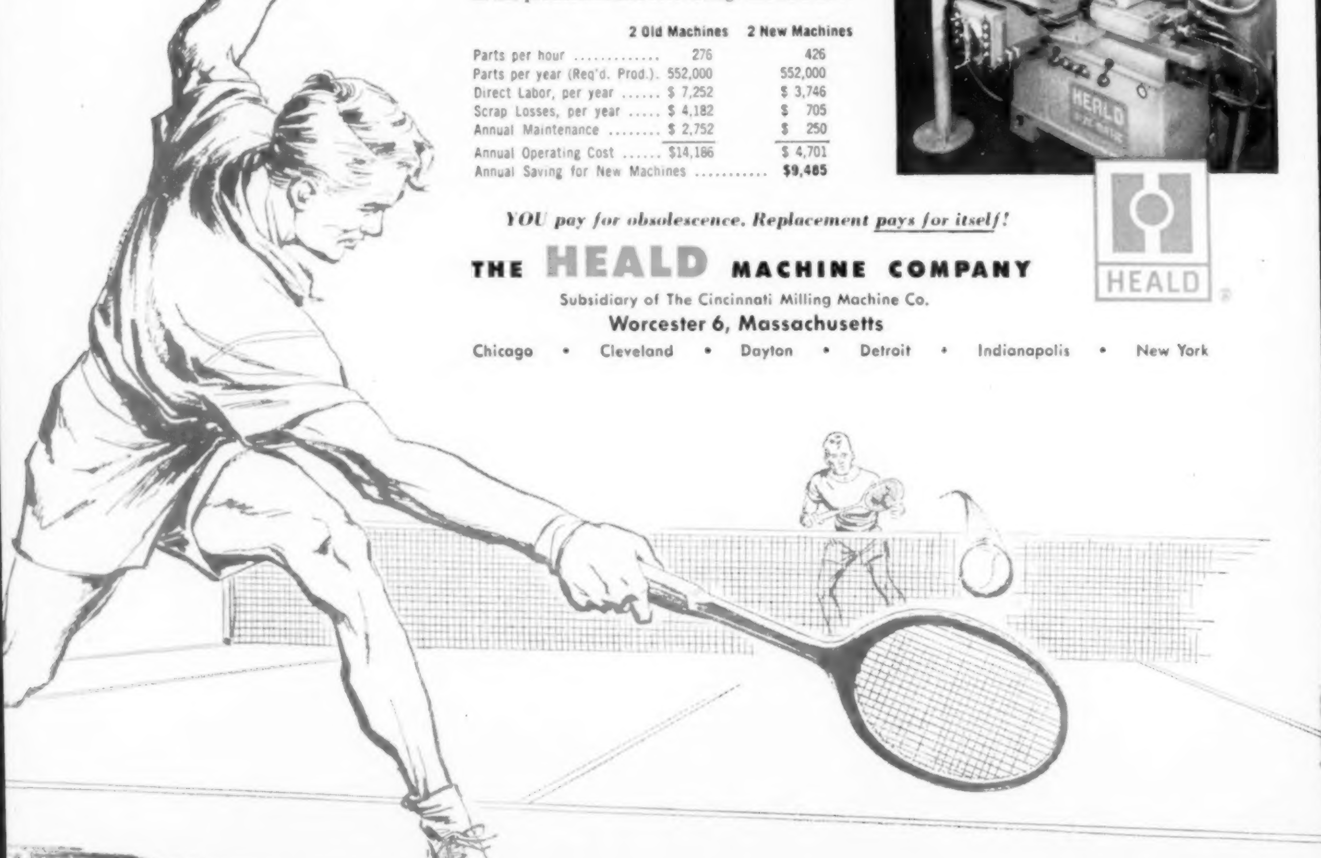
it's mainly a matter of TIMING!

But WHEN to replace a machine depends on more than its age

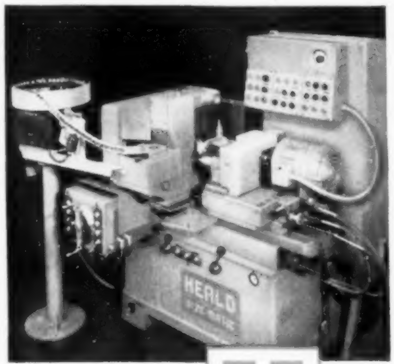
YEARS ALONE don't tell you when a machine has reached retirement age. In fact the age of a machine may be a relatively minor factor in computing the time at which it should be replaced. Some old machines may still have many years of economically productive life. While more recent ones, of a different type, may have already outlived their profitability in your plant.

It depends on many variable factors—including the comparative efficiency of the proposed new machine, and any design improvements which will become available in the foreseeable future. But whatever the replacement conditions, proper timing can mean the difference between *profit* and *loss*. Too early is just as bad as too late. But there is *one* mathematically predictable time when replacement will cost you the least amount of money. This replacement minimum can't be determined by guesswork, intuition, or rule-of-thumb. It requires precise methods of replacement analysis, based on proved economic principles.

Our sales engineers are well experienced in making such obsolescence studies. And they will be glad to do the same for you. Similar studies by Heald engineers have pointed the way to many important *savings*.



For Example: A manufacturer of automotive parts was using two ten-year-old Heald Model 81 Centerless Internals for grinding a blind hole in steel bushings. A cost analysis showed that two new Heald Model 180 Centerless Internals, like that shown at the right, could do the *same job* at a saving of more than 66% in total operating cost. The replacement of the two old machines with two new ones resulted in the production and cost savings shown below.



	2 Old Machines	2 New Machines
Parts per hour	276	426
Parts per year (Req'd. Prod.)	552,000	552,000
Direct Labor, per year	$ 7,252	$ 3,746
Scrap Losses, per year	$ 4,182	$ 705
Annual Maintenance	$ 2,752	$ 250
Annual Operating Cost	$14,186	$ 4,701
Annual Saving for New Machines		**$9,485**

YOU pay for obsolescence. Replacement pays for itself!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

the tool engineer

Vol. 40, No. 6 June 1958

Reliability Requirements for Tomorrow's Competition .... *By H. Thomas Hallowell, Jr.* 71
Today's high reliability standards will be raised even higher. Building reliable products is a tool engineering responsibility.

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THIS MONTH'S COVER

As hole tolerances become smaller, and surface finish requirements are made more exacting, gun drills and reamers are being more extensively applied. The operation shown illustrates the principle of gun drilling—coolant is forced through the tool at high pressure, flushing away chips as they are generated. Tool design and application are covered in the article starting on page 79.

THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Industrial Arts Index*.

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Made in America!

Our standard of living is made in America on machine tools. That is the slogan announced at the Machine Tool Distributors' meeting in New Orleans. Although a basic truth, the American genius for mass production lies behind it. The work of Eli Whitney and others pointed the way toward making more and better products at less cost.

American products have always been considered top quality throughout the world. Always there were ready and eager markets. Now, machine tool and other important markets are shrinking. These products have virtually been priced out of the market. Instead of building protective fences, let's re-establish our position through the same virtues that made us great and the envy of the world.

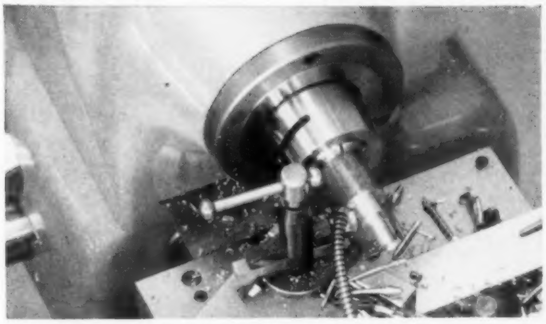
Yankee ingenuity is resourceful. It often turns a liability into an asset. An excellent example of utilizing a basic limitation to advantage is incorporated in a new Brown and Sharpe cylindrical grinder. Feed and positioning devices have inherent backlash and can only repeat within certain tolerances. Deflections in a system, however, caused by an applied load always return to original position if the system is elastic such as the bed of a grinder. To control the finish size within a few millionths inch of gage reading on this grinder, a controllable hydraulic pressure is exerted against the grinder bed until desired reading is obtained. With the regular feed controls remaining unchanged during finish grinding, the deflection of the bed is controllable and repeatable at will of the operator.

That is ingenuity at work. With that type of engineering America will always remain great!

John W Greve
EDITOR

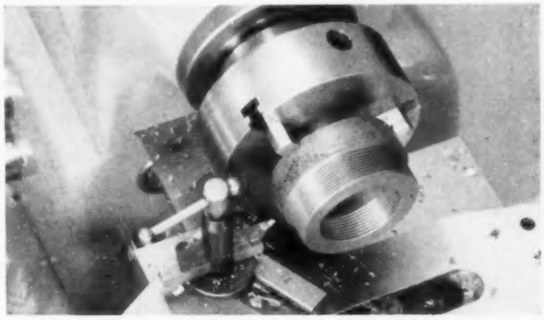
HARDINGE
ELMIRA, N.Y.

"The Outstanding Tool Room Lathe"



Precision Collet work for all sizes to 1 – 1/16" Collet seats *directly* in spindle.

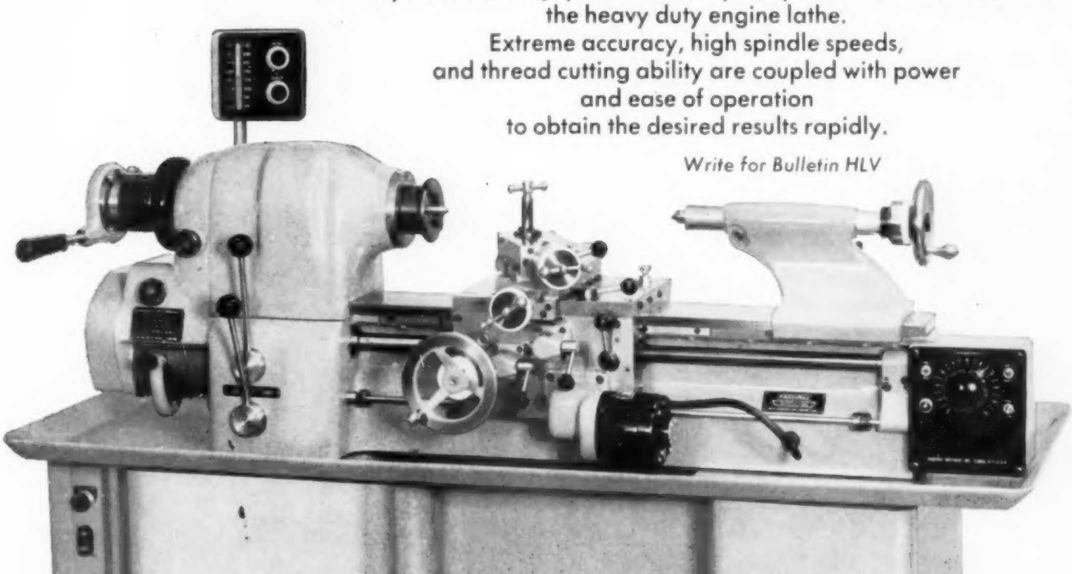
Precision Step Chucks for diameters up to 6". Provides Collet-like accuracy.



Integral Mount Jaw Chucks for precision holding of regular or irregular shapes up to 5".

Hardinge Model HLV 10" Lathe was primarily designed to fill a very old existent gap between the plain precision bench lathe and the heavy duty engine lathe.
Extreme accuracy, high spindle speeds, and thread cutting ability are coupled with power and ease of operation to obtain the desired results rapidly.

Write for Bulletin HLV



HARDINGE BROTHERS, INC., ELMIRA, N. Y.

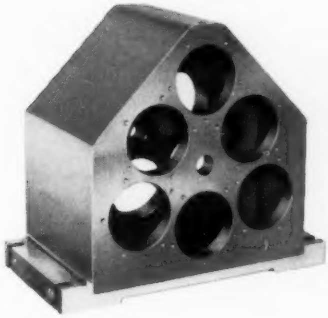
OFFICES IN PRINCIPAL CITIES. Export Office: 269 Lafayette St., New York 12, N. Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-6-5

here's a

PRECISION SIX-HOLER

with a hole-to-hole tolerance of two ten-thousandths



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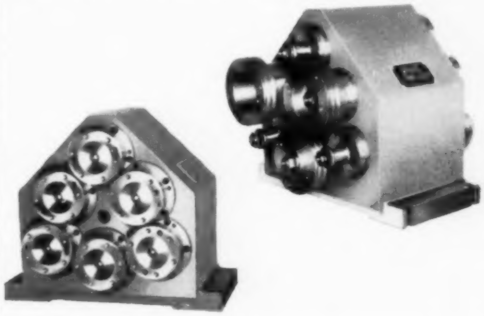
the **POPE**

Special **6-SPINDLE**

BORING HEAD



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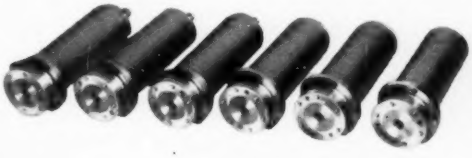
equipped with

POPE

Heavy Duty Precision Boring Spindles



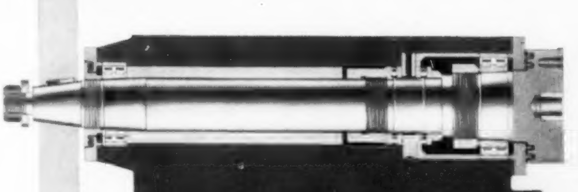
the Spindles that are capable of boring holes round within *millionths of an inch,* and that produce fine surface finishes in the lower micro inch range.

POPE designs, engineers and builds a wide range of **SPECIAL SPINDLES**

This sectional view shows you why Pope Boring Spindles provide dependable, trouble-free operation and continuous production of accurate parts.

Roller bearings rigidly support the tool for smooth, chatter-free operation.

Preloaded, super-precision thrust bearings eliminate endwise movement of the shaft in either direction.



No. 123

POPE®

ENGINEERS AND BUILDS STANDARD AND SPECIAL PRECISION ANTI-FRICTION BEARING SPINDLES FOR EVERY PURPOSE

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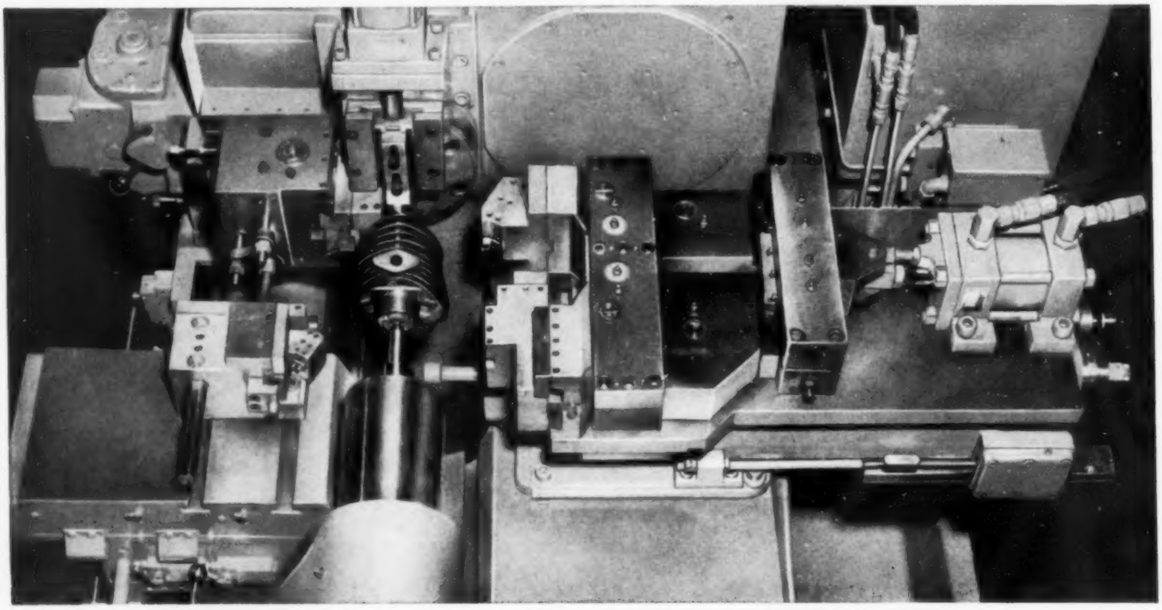
Established 1920

Six different sizes and types of workpieces are handled easily on this job. Extra expanding mandrel and sleeves at right are for different sizes.



How Harley-Davidson speeds motorcycle part production

Machines both ends in single chucking, using Gisholt No. 12 Automatic to get maximum accuracy, cut production costs

This well-planned setup reveals how Harley-Davidson Motor Co., Milwaukee, Wis., is handling cast iron front and rear cylinders.

Smart tooling on a Gisholt MASTERLINE No. 12 Automatic Production Lathe handles 6 different sizes and types of workpieces. Change-over is fast and easy. A special headstock-mounted, air-operated locating stop speeds work handling.

While tools in the front carriage turn and chamfer at one end of the piece, tools in a headstock-mounted auxiliary slide chamfer the I.D. on the other side. Simultaneously, tools on the rear slide face both ends for length. At the end of the cut, tool blocks on the rear independent slide swing open automatically to provide tool relief before withdrawal. Floor-to-floor time on the part shown is 1.2 minutes, only 1.8 to 3.6 minutes for the other 5 workpiece types and sizes.

The new Gisholt MASTERLINE No. 12 Automatic Production Lathe is designed specifically for high production operations; yet, it is flexible enough to handle a variety of similar parts in small repeat lots. The automatic cycle frees the operator to handle other machines or do other work.

Make a note to phone your Gisholt Representative today. Ask him to come in and show you where the fast automatic cycle and flexibility of the No. 12 Automatic Production Lathe can cut your floor-to-floor time and reduce your costs.

MASTERLINE GISHOLT SINCE 1887 GISHOLT

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin, U.S.A.

WRITE GISHOLT TODAY for advance data on the new Gisholt MASTERLINE No. 12 Automatic Production Lathe. Ask for Form 1178.

ASK YOUR GISHOLT REPRESENTATIVE ABOUT GISHOLT FACTORY REBUILT MACHINES WITH NEW MACHINE GUARANTEE

ARBOR-LOC®

CINCINNATI'S NEWEST FEATURE

Reduces Setup Time

Standard Cincinnati Arbors interchanged in *seconds!*

ARBOR-LOC is a big timesaver in interchanging the seven cutting tools on the table of the CINCINNATI Dial Type Milling Machine illustrated here.

Saving time and money in multiple operation milling is simple with the new ARBOR-LOC formula: multiply a minute or more x tool changes x pieces per lot. ARBOR-LOC is a new cost-reducing feature incorporated in *most CINCINNATI knee-and-column milling machines. It gives the operator an opportunity to quickly and safely change cutters and arbors as often as required. Just picture these ARBOR-LOC advantages for your own shop:

Increases productivity of the machine for short runs. Arbors can be changed in a few seconds' time.

No need for special-purpose quick-change accessories for multiple operations. ARBOR-LOC accommodates Cincinnati's complete new line of standard No. 50 flanged arbors and adapters.

Simplifies tooling problems through more complete standardization of arbors and similar accessories.

Quickly assembled and removed for setups where not required, such as for face milling cutters.

Does not restrict use of existing arbors, adapters, etc.

*The following CINCINNATI knee-and-column milling machines are equipped with ARBOR-LOC spindle nose: Nos. 2ML; 2 and 3MI; 2, 3 and 4 Dial Type; 2 and 3 High Power Dial Type; 2 and 3 Dual Power Dial Type; plain, universal and vertical styles. You may obtain more information by writing for publication No. M-2016.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

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MILLING MACHINES • BROACHING MACHINES • CUTTER AND TOOL GRINDERS • SPECIAL MACHINE TOOLS • METAL FORMING MACHINES HARDENING MACHINES • CUTTING FLUIDS • GRINDING WHEELS

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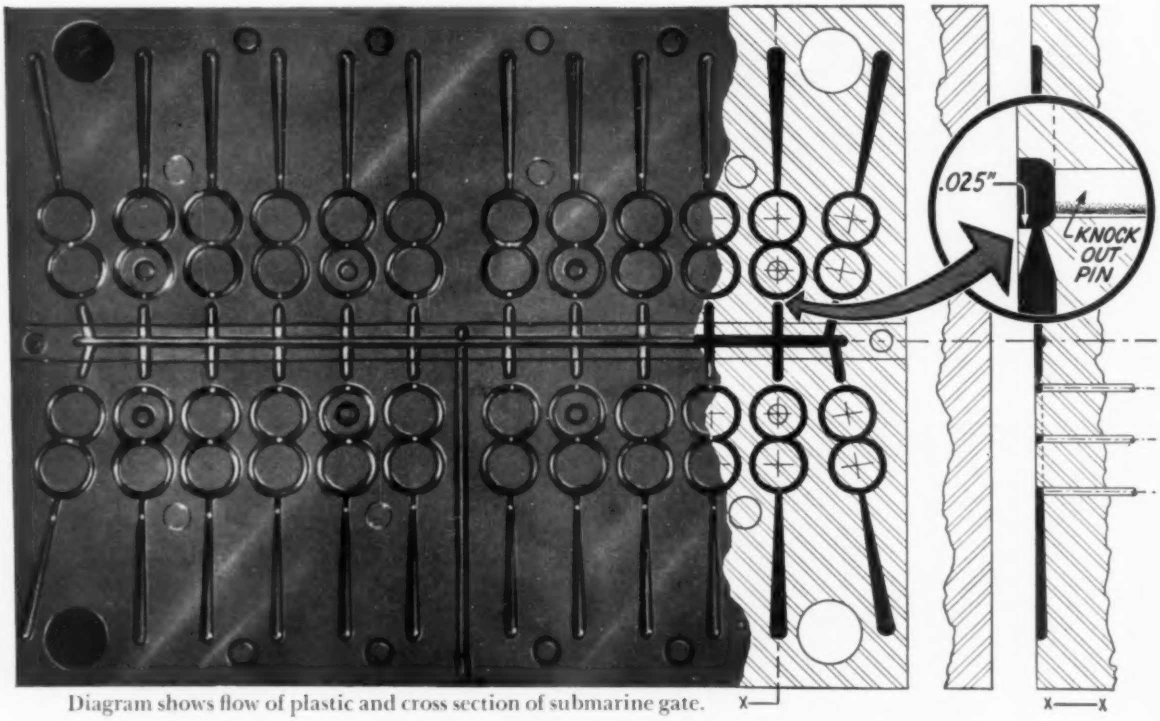

Diagram shows flow of plastic and cross section of submarine gate.

How Much Dimensional Stability Can You Demand From A Tool Steel?

Plenty, Case History Of UDDEHOLM's UHB-151 Shows

Just how much dimensional stability *can* you ask from a tool steel without risking injury to your investment? Quite a bit, actually, *depending on your choice of tool steel.* In the injection mold illustrated above Uddeholm's air-hardening UHB-151 gave a remarkable example of such stability. Any excess movement of the steel during hardening would have ruined the mold. Edge-fed, with 24 cavities, this mold produces styrene plastic "bubble wand" prizes for children. Each cavity has three knock-out pins—a total of 72. These pins must fit a .093" diameter hole snugly enough to prevent flashing, yet cannot bind. Tolerance for depth of cavities across corners of blocks was only ±.00025"! The submarine gates, also drilled before hardening, were just .025" off cavity edge—leaving a tiny triangle of steel supported by only that thickness.

Utmost safety in hardening was needed to prevent the small submarine gate piece from cracking—and to hold the knock-out pin holes to required tolerance. Excellent non-deformity was needed to assure perfect meeting of the two die halves. Perfection Plastic Engineering Co., of Philadelphia, maker and user of the die, chose Uddeholm's UHB-151 to do the job.

Among Uddeholm's wide selection of fine, Swedish-quality tool steels you can always find one to meet your specific demands. And each Uddeholm sales representative is a tool steel specialist. You can always depend on him to recommend the tool steel best suited to your job. Call on him whenever you need tool steel service or information.

Write For Tool Steel Stock List No. 12

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UDDEHOLM COMPANY OF AMERICA, INC.

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Specialty Strip Steels

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Cleveland: 4540 East 71st Street, DIamond 1-1110
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PHILADELPHIA: Frank T. Campagna, 34 South 17th Street, RIttenhouse 6-4290

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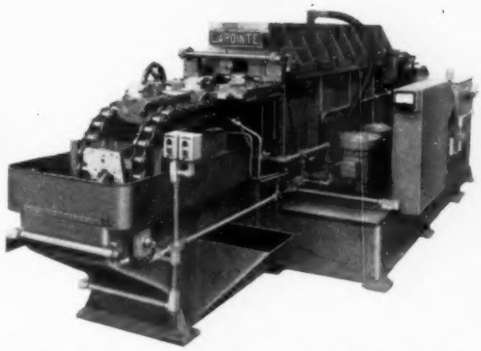
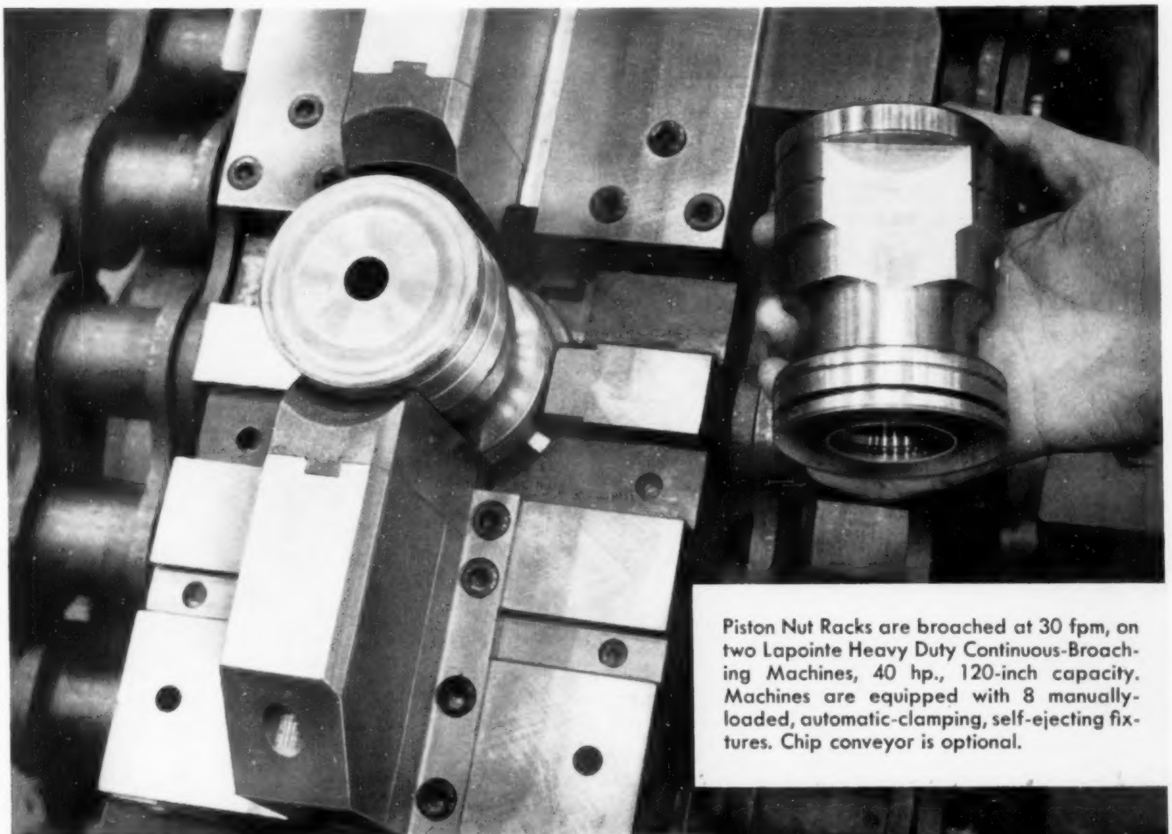
Using two LAPOINTE continuous BROACHING MACHINES,



one for roughing and the other for finishing, production is 800 completely broached piston nut racks per hour . . . with reserve capacity still available if needed. The picture indicates the large amount of stock that is removed in *accurately* straddle-broaching the flats and adjacent angular surfaces. If you're really serious in your desire to cut production costs, you should consider converting to broaching — *modern broaching*, that is, by Lapointe. Send for Bulletin CH-1.



Piston Nut Racks are broached at 30 fpm, on two Lapointe Heavy Duty Continuous-Broaching Machines, 40 hp., 120-inch capacity. Machines are equipped with 8 manually-loaded, automatic-clamping, self-ejecting fixtures. Chip conveyor is optional.

THE LAPOINTE MACHINE TOOL COMPANY

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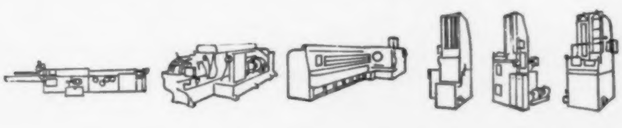

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known to be the best in **BROACHING**

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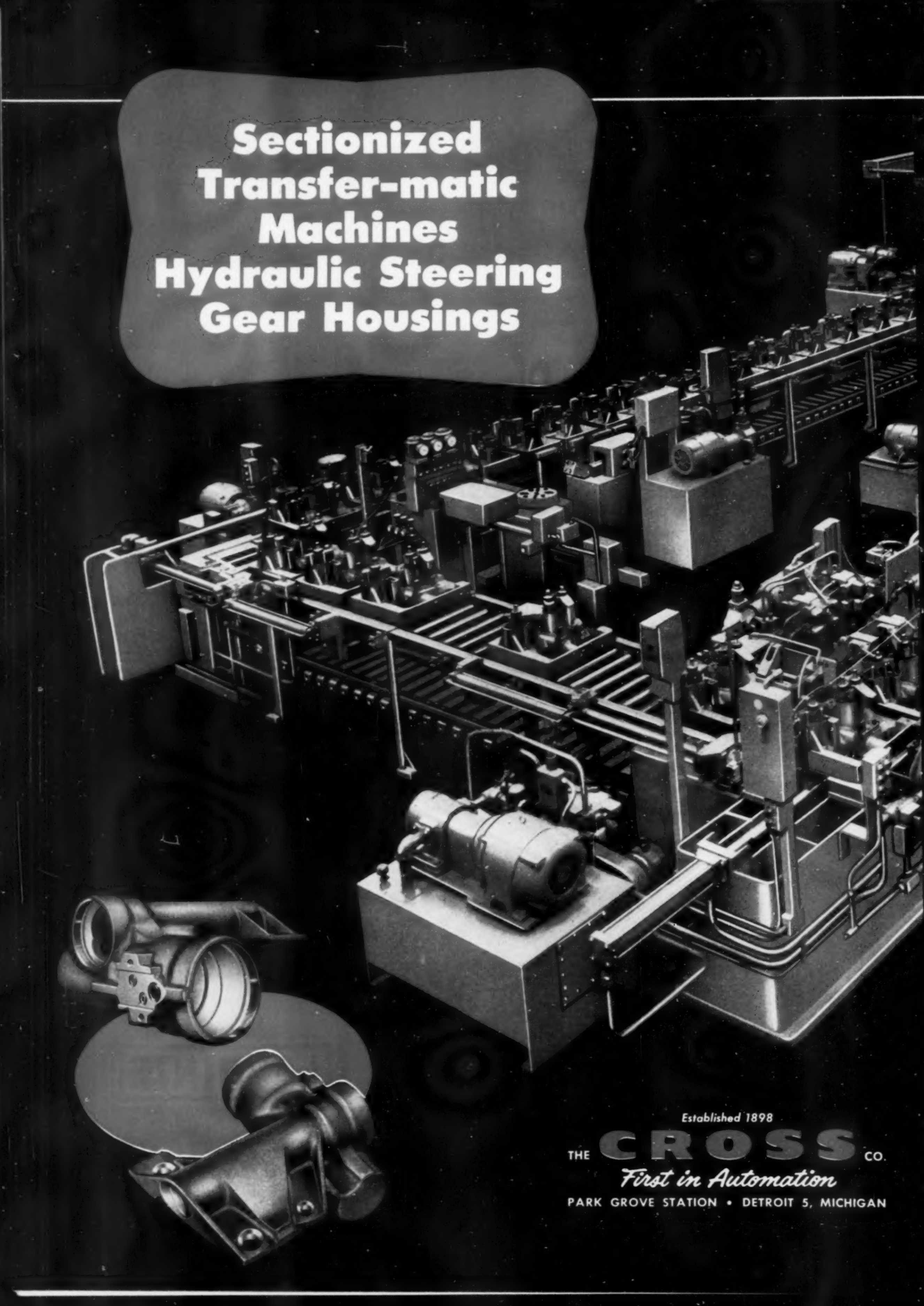
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Hydraulic Steering
Gear Housings
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First in Automation
PARK GROVE STATION • DETROIT 5, MICHIGAN

DoALL Exclusive

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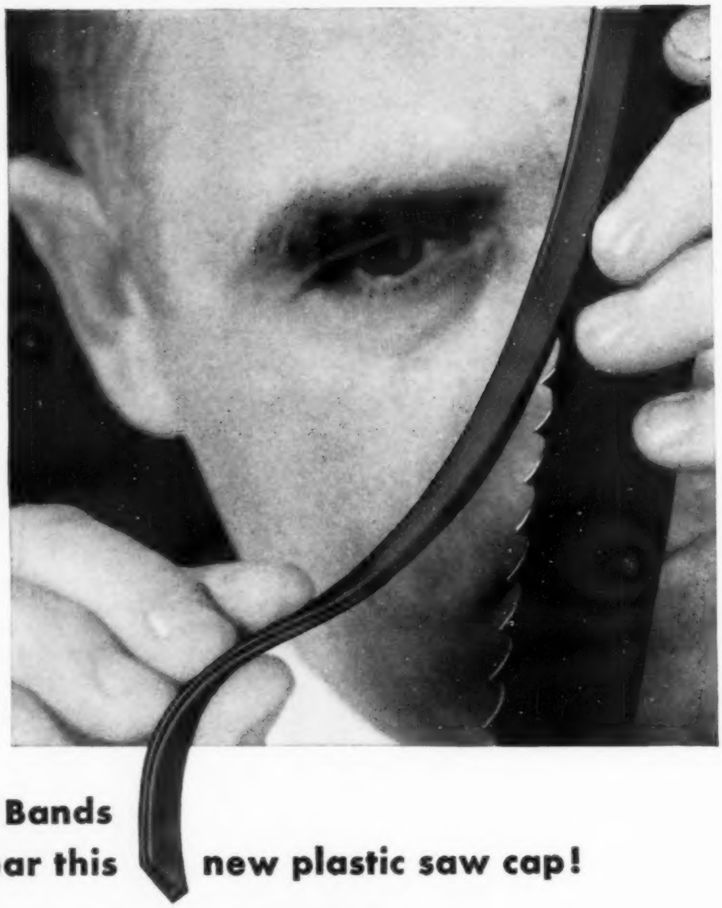
for World's Fastest Cutting Saw Bands!



Demon HIGH-SPEED STEEL **Saw Bands now wear this new plastic saw cap!**

No added cost for this protection to all Demon Saw Bands:

Demon HIGH-SPEED STEEL

AVAILABLE IN THREE TOOTH TYPES

Precision®

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Claw Tooth®

To provide full protection for the fine cutting tool it is, Demon High-Speed Steel Saw Band now comes to you in this continuous plastic shield. No nicking . . . no chipping . . . no scoring . . . no dulling. No harm can come to its precision qualities in coiling, shipping, handling.

In this new era of production when band machining is replacing costlier practices in thousands of plants, the Demon Blade brings extra speed, extra earnings, *extra production advantages*. Indeed, here is cutting performance so remarkable that these high speed steel saw bands outlast carbon steel saw bands up to 30 times . . . give you *ten* times the cutting speed in cutoff and contour sawing.

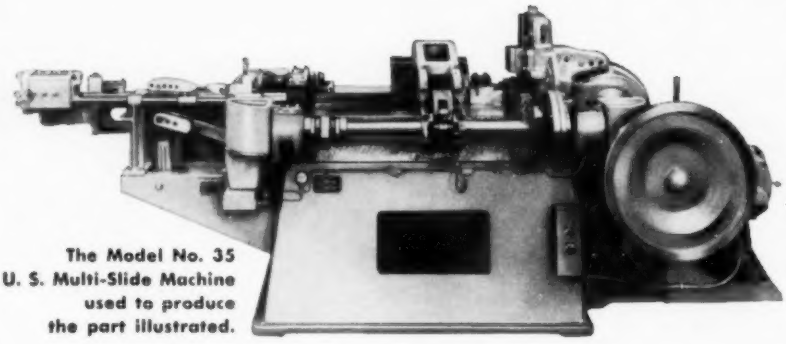
Right now—get all the facts about Demon HSS Saw Bands, the *precision-protected* saw bands that radically cut costs through super-speed, super-long sawing service. Call your local DoALL store, or write:

SB-61

Free—
SAW SELECTOR WALL CHART
Get Yours Today!

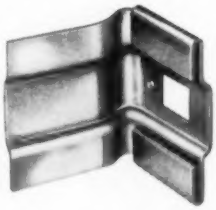
THE DoALL COMPANY Des Plaines, Illinois

This is a typical DoALL store.



The Model No. 35 U. S. Multi-Slide Machine used to produce the part illustrated.

U. S. MULTI-SLIDE® MACHINES ELIMINATE SECONDARY OPERATIONS



The cost saving potential of U. S. Multi-Slide Machines is, once more, demonstrated here in the economical production of a stamped automotive part.

By using the No. 35 U. S. Multi-Slide, the Production Metal Stamping Company of Toledo, Ohio is able to completely eliminate all secondary operations and handlings in the production of the formed stamping illustrated.

The No. 35 U. S. Multi-Slide produces this part in one operation. Cold rolled steel .059" thick by 3.210" wide is fed into the machine from coils and finished parts are produced at the rate of 85 per minute.

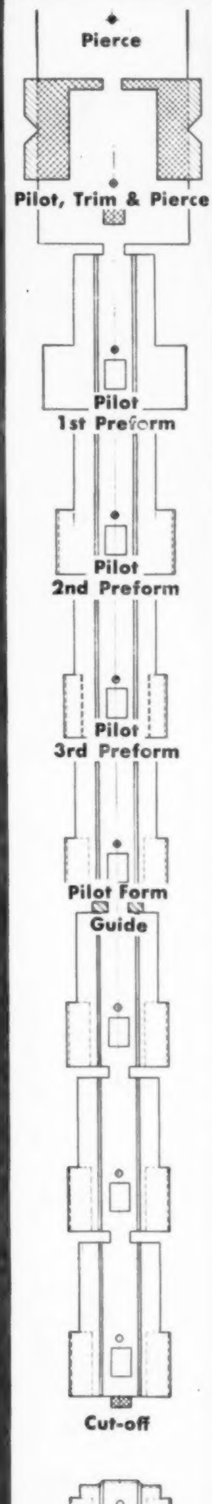
Each of the four models of U. S. Multi-Slide Machines is designed for the economical production of stampings. They are adaptable to the manufacture of wire parts as well as stampings from flat coil stock. In some instances more than one strip can be fed into a U. S. Multi-Slide for processing and completing an assembly. Prefabricated parts can be hoppered, positioned and assembled to the stampings being made while still in the machine. It is because of this versatility that the use of U. S. Multi-Slide Machines can considerably lower your component costs.

For the uniform, economical production of stampings — write for your copy of the U. S. Multi-Slide Bulletin No. 15-T — or send us your part drawings or samples for our recommendation.

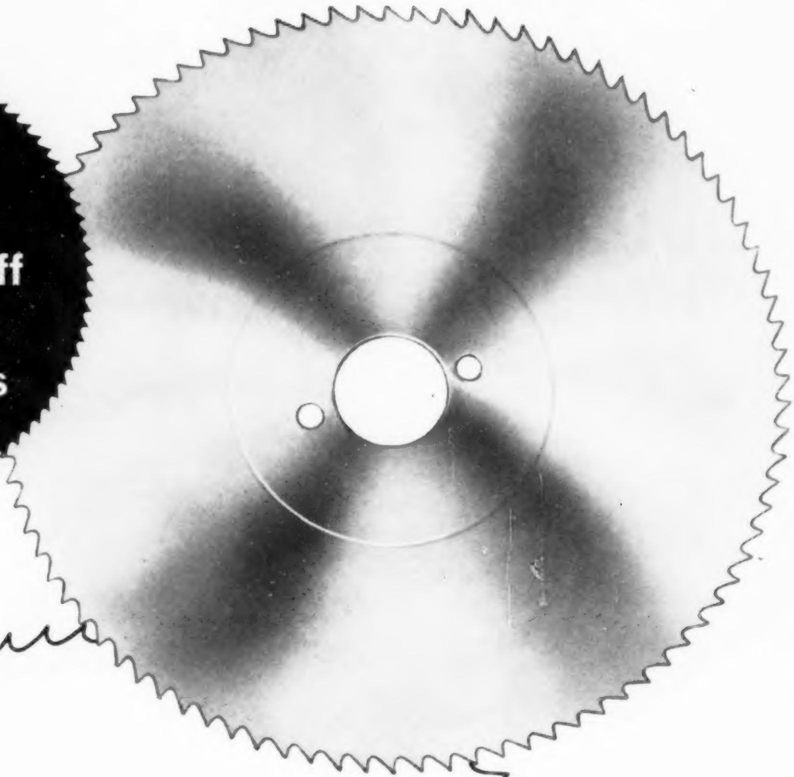
MULTI-SLIDE

U. S. TOOL COMPANY, INC. AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories



NEW M & M blade speeds up cut-off of soft metals and their alloys



Higher speed to boost output, greater accuracy to step up quality—that's what you'll get when you cut off soft metals and their alloys with Motch & Merryweather's new, specially-engineered PolyMetal Blade.

This new blade is tougher, longer lasting. It's made of special analysis steel that combines desirable hardness, strength, shock resistance, toughness and wear resistance to produce just the right blade for metals like aluminum, magnesium, brass, bronze, copper and their alloys.

In M & M's PolyMetal Blade you get other outstanding features, too. Typical examples:

- **suitability for use on either hand or mechanically fed sawing machines**
- **uninterrupted performance—month in and month out**
- **easier sharpening to original cutting efficiency without special sharpening equipment**

Learn more about the PolyMetal Blade and the many advantages of making your local M & M dealer your single source for cutting tools. Call him today and whenever you have troublesome cutting problems.

FREE—Send today for your copy of M & M's Circular Sawing Handbook, a pocket-sized guide to sawing operations.

MOTCH AND MERRYWEATHER

Cutting Tool Manufacturing Division
CLEVELAND 17, OHIO

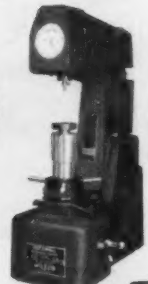
Q *Quality*
S *Service*
A *Availability*

WILSON "ROCKWELL"

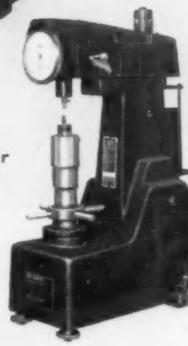
HARDNESS TESTERS
WORLD'S STANDARD OF ACCURACY

ACCO
for Better Values

EQUIPMENT for EVERY Hardness Testing Requirement



"ROCKWELL"



Twintester

No matter what your hardness testing requirements are, there's a WILSON "ROCKWELL" instrument to do the job. Choose from this complete selection of hardness testers:

"ROCKWELL"—for most hardness testing functions.

Superficial—for extremely shallow indentations.

Twintester—combines functions of "ROCKWELL" and "ROCKWELL" Superficial testers.

Semi-Automatic (manual feed) and Fully Automatic—for automatically classifying tested pieces as CORRECT, TOO HARD, or TOO SOFT—at test rates up to 1000 pieces per hour.

Special Machines—for testing large objects, obtaining internal readings, and other unusual applications.

ALL WILSON "ROCKWELL" hardness testers provide these advantages:

Accurate performance—precision built, with exact calibration, for consistently correct results.

Long life—durable as a machine tool.

Easy operation—even an unskilled operator can get perfect readings. All controls conveniently grouped.

Easy maintenance—interchangeable mechanisms, with spindles mounted on oil-less bearings.

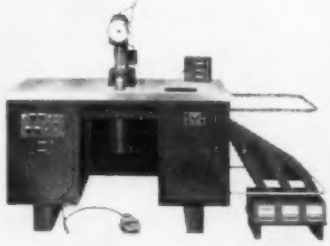
Superficial

DIAMOND "BRALE" PENETRATORS

for perfect testing every time

A perfect diamond penetrator is essential to accurate hardness testing. Since one point of hardness on the "ROCKWELL" scale represents only 80 millionths of an inch of penetration—only 40 millionths on a Superficial tester—the slightest imperfection will cause a false reading.

Only *perfect* Wilson Diamond Brale Penetrators are sold. Each diamond is flawless, with no chips or cracks. It's cut to an exact shape. Microscopic inspection and a comparator check of every diamond—one at a time—assure this perfection—and assure you of accurate hardness testing every time.



Automatic

A COMPLETE LIBRARY of Helpful Information

A wide variety of bulletins tells about hardness testing, and describes the many instruments, accessories, and services Wilson offers. Write for your choice:

DH-325—WILSON "ROCKWELL" Hardness Testers • **DH-326**—"ROCKWELL" Superficial Hardness Testers • **TT-58**—"ROCKWELL" Twintester • **DH-327**—Special "ROCKWELL" Testers, including Automatic and Semi-Automatic models • **DH-328**—TUKON Tester, for precision MICRO and MACRO testing

TUKON Tester
(for MICRO and MACRO testing)

ACCO WILSON
MECHANICAL INSTRUMENT DIVISION
AMERICAN CHAIN & CABLE
230-H Park Avenue, New York 17, N. Y.

How to find a better heat-treating method

Here's a sound way to do it. Take your problems to the people who have consistently, over the years, provided the metal treating industry with new and better ideas, more efficient, more practical equipment. This will bring you to Lindberg, creators of the famous Cyclone type atmosphere furnaces, the long-life "dimple" vertical radiant tube, the revolutionary new CORRTHERM electric heating element and so many other innovations in better heat treating methods. Lindberg is synonymous with heat treating furnaces. We build them for carbonitriding, carburizing, hardening, tempering, normalizing, bright stainless annealing, brazing, carbon correction, nitriding, or any other metal treating requirement. Give your production processes the advantages of Lindberg's forward look in "heat for industry" techniques. Get in touch with your nearest Lindberg Field Representative (See classified phone book) or write Heat Treating Furnace Division, Lindberg Engineering Company, 2447 W. Hubbard St., Chicago 12, Illinois.

LINDBERG **heat for industry**

HERE'S REAL FLATNESS! *Dow magnesium tooling plate flatness is measured as the maximum deviation under a straightedge.*

NEW! CLOSER FLATNESS TOLERANCES IN DOW MAGNESIUM TOOLING PLATE

PRECISION PLUS. Now you can buy this lightweight tooling metal with closer flatness tolerances than ever before. With new production methods Dow magnesium tooling plate is now manufactured to these tolerances:

	In any one foot		In any 6 feet	
THICKNESS	GUARANTEED	TYPICAL	GUARANTEED	TYPICAL
0.250"-1.000"	0.005	0.003	0.015	0.007
1.001"-6.000"	0.010	0.005	0.020	0.010

COSTS NO MORE. This big improvement in quality and value costs you not one penny more! Dow magnesium tooling plate STILL costs less than other lightweight tooling metals. You save money twice—once when you buy it and again when you use it.

Magnesium tooling plate is low in cost because it is rolled (not machined) to a flatness satisfactory for virtually all tooling purposes.

Next time you need a tooling metal, get in touch with one of the Dow magnesium suppliers listed below. A trial will convince you it pays to switch to magnesium. THE DOW CHEMICAL COMPANY, Magnesium Sales Department, Midland, Michigan, MA 1430A.

AVAILABLE FROM STOCK AT:

COPPER AND BRASS SALES, Detroit 12, Michigan
FULLERTON STEEL AND WIRE CO., Chicago, Illinois
HUBBELL METALS INC., St. Louis 3, Missouri
A. R. PURDY CO., INC., Lyndhurst, New Jersey
RELIANCE MAGNESIUM COMPANY, Los Angeles, California
VINSON STEEL AND ALUMINUM COMPANY, Dallas, Texas

YOU CAN DEPEND ON DOW

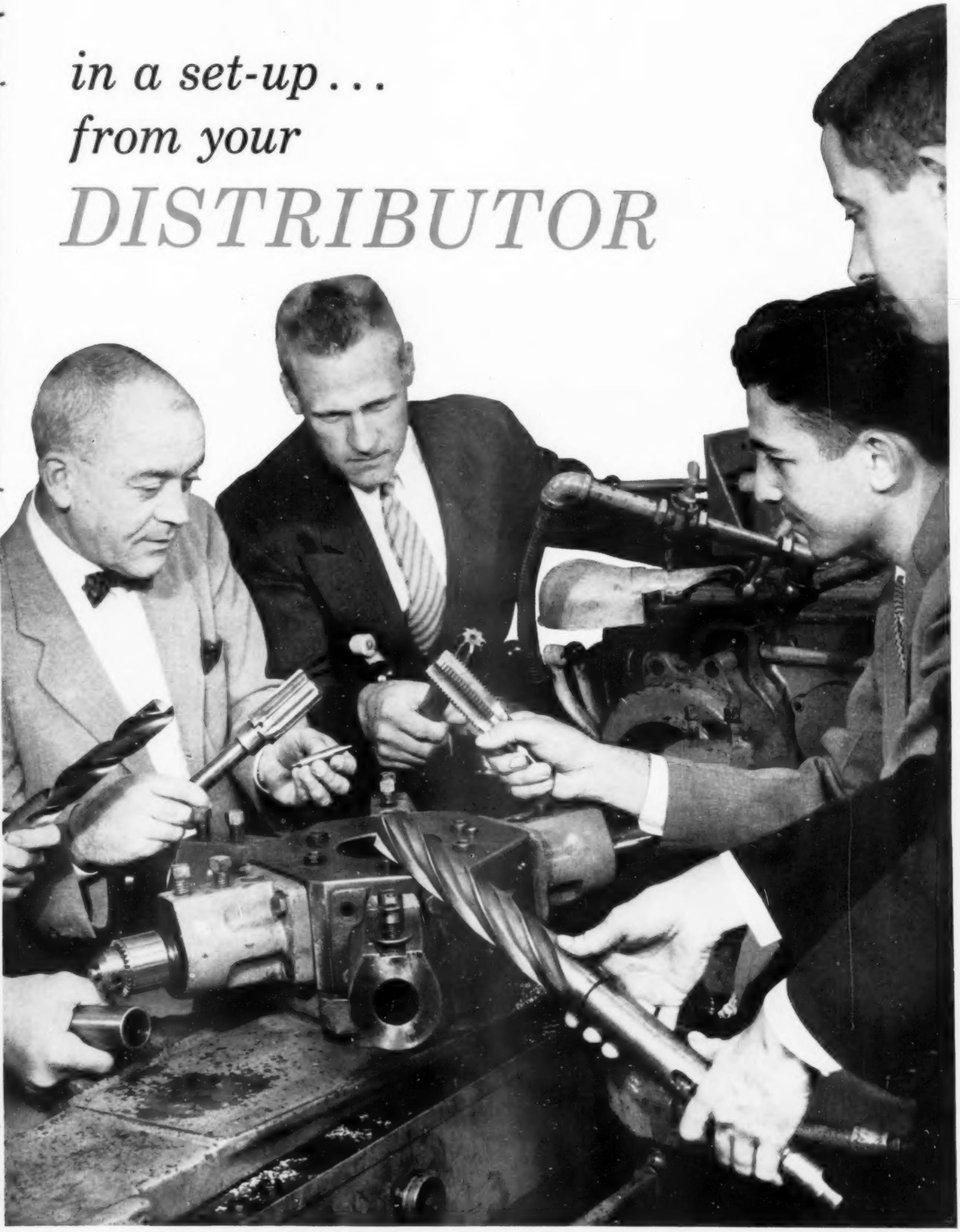
Lindberg pioneers in High Frequency Heating

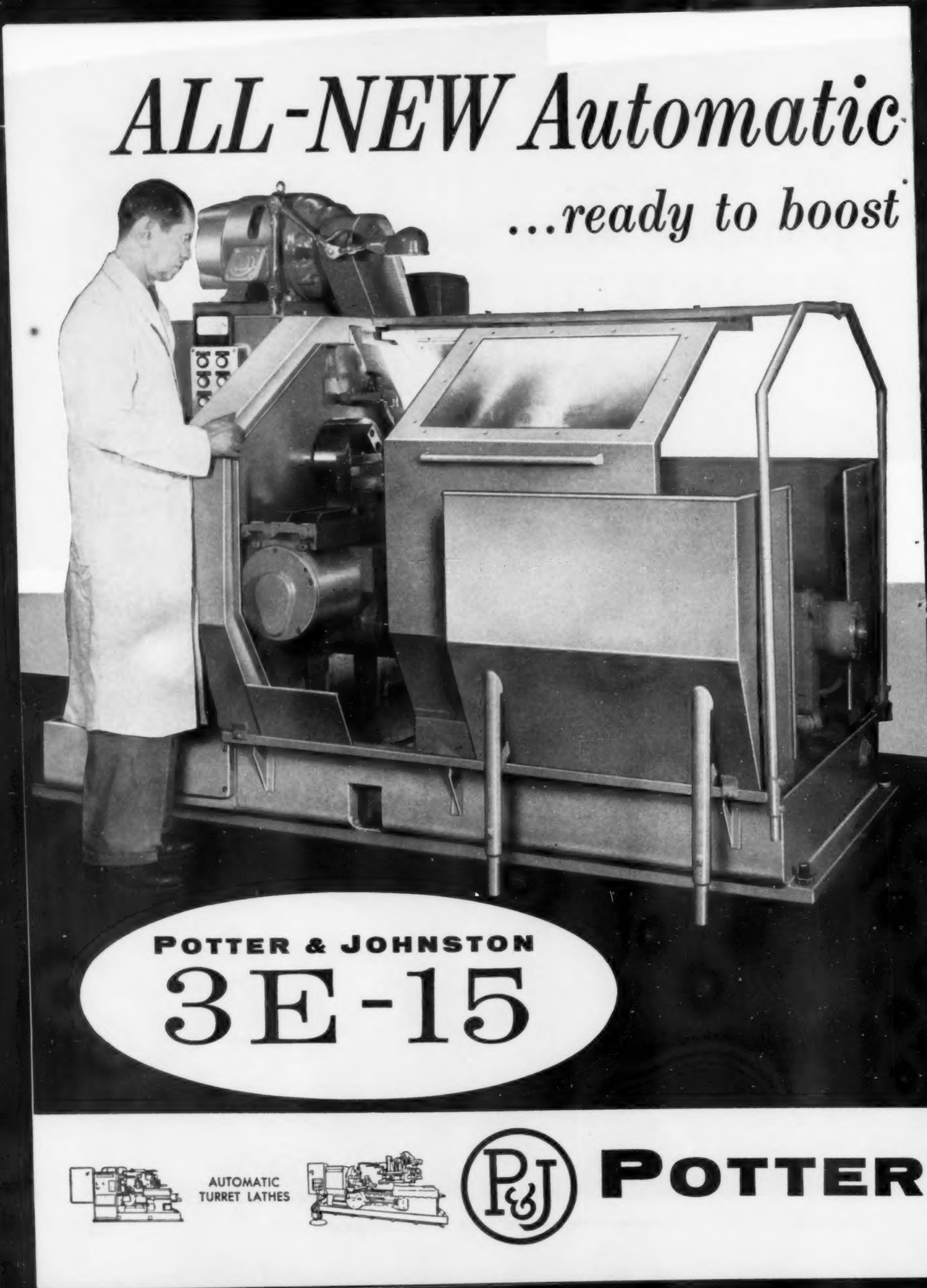
Along with its pioneering in all phases of "heat for industry" Lindberg is one of the largest makers of High Frequency heating units. Our "H-F" designers and engineers have made outstanding developments in this important heat treating field. For example, we illustrate a remarkable unit just recently completed for aluminizing automotive valves. It was designed vertically, saving 60% of floor space, and is completely automatic. No operator is required. It fits perfectly into an automated production line.

Our High Frequency Division provides units for hardening, brazing, heating for forging and forming, annealing and many other processes, and designs a variety of fixtures for application to "H-F" units. Lindberg also supplies a complete line of motor generators for all induction heating and melting applications. Get in touch with your nearest Lindberg Field Representative (See classified phone book) or write High Frequency Division, Lindberg Engineering Company, 2447 W. Hubbard St., Chicago 12, Illinois.

LINDBERG heat for industry

in a set-up . . .
from your
DISTRIBUTOR




ALL-NEW Automatic
...ready to boost
POTTER & JOHNSTON
3E-15
AUTOMATIC
TURRET LATHES
P&J
POTTER

Turret Lathe

YOUR production!

To help you produce parts faster and at lower cost, the Potter & Johnston 3E-15 Automatic Turret Lathe offers every advanced feature you've been looking for. It's completely new in design and construction. This machine gives you the power and extra rigidity you need to hog out tough alloys faster . . . plus the precision you want to hold closer tolerances and produce smooth finishes. Set-up is fast and easy, saving valuable time and insuring lowest per-part costs on both short and long runs. Real tooling versatility will help you machine the most complicated cuts with new speed and efficiency. The 10-inch chuck capacity combined with wide speed and feed ranges will let you handle a very broad variety of work types and sizes.

HERE'S EVERYTHING YOU NEED TO HANDLE YOUR JOBS FASTER, BETTER, MORE PROFITABLY —

FASTER METAL REMOVAL

- **INCREASED POWER** . . . with all-new 15 hp headstock for fast accurate removal of the toughest alloys.
- **GREATER RIGIDITY THROUGHOUT** . . . with new, heavy steel weldment base and hardened-and-ground tool steel ways.
- **TURRET COOLANT SYSTEM** . . . in addition to overhead system. Lets you pump coolant through turret tools for maximum efficiency in drilling, boring and other internal machining operations.

FASTER SET-UP

- **NEW CROSS SLIDE CONTROL** . . . with selector switches now provides faster, easier set-up for delayed or on-time movement. Cross slides can be operated together or independently with any turret face and can be adjusted longitudinally, independent of each other.
- **NEW INDEPENDENT MOTOR DRIVE FOR TURRET INDEXING** . . . permits indexing during set-up without forward travel of the turret.
- **EXTRA-LARGE CONTROL DRUM** . . . located for easy access, insures fast programming of all machine functions including automatic speed and feed changes, rapid traverse, etc.
- **6-FACE TURRET** . . . allows opportunities for greater tooling flexibility.

REDUCED MAINTENANCE

- **ELECTRIC CLUTCHES THROUGHOUT** . . . are self-compensating for wear, require no adjustment.
- **CENTRALIZED AUTOMATIC LUBRICATION** . . . for turret slide, cross slide and base, reduces wear and insures smooth operation of all moving parts.

SEND NOW FOR THE FACTS . . . *mail this coupon today for your free copy of Bulletin No. 172. Contains complete data and specifications on the new Potter & Johnston 3E-15 Automatic. If you prefer, ask a P&J Representative to call and discuss its advantages with you. There is no obligation, of course.*

POTTER & JOHNSTON COMPANY
Newport Avenue, Pawtucket, Rhode Island
Without obligation —

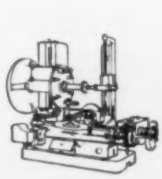
☐ Please send my copy of Bulletin No. 172, with all the facts on the new P&J 3E-15 Automatic Turret Lathe.
☐ Please have a P&J Representative call and show how a P&J 3E-15 can help me cut costs.

name__________
position__________
company__________
co. address__________
city__________ zone_____ state_____

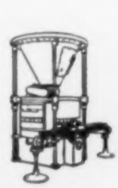
& JOHNSTON

SUBSIDIARY OF PRATT & WHITNEY COMPANY, INC.

PRECISION PRODUCTION TOOLING SINCE 1898



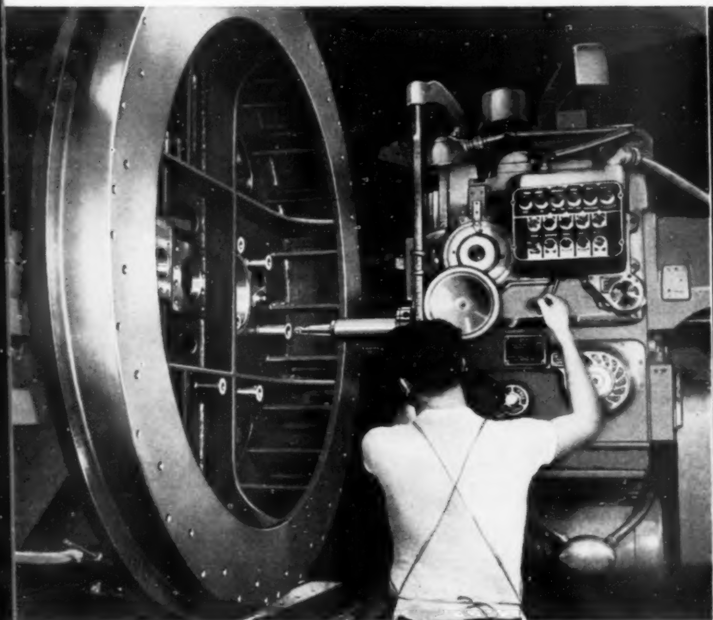
GEAR CUTTERS



PACKAGING MACHINES

SOME OF OUR JIGMIL USERS

Airesearch Mfg. Co., Div. The Garrett Corp.
Bell & Gossett Co.
The Brush Beryllium Co.
H. W. Butterworth & Sons Co.
Byron Jackson Pumps, Inc.,
a Subsidiary of Borg-Warner Corp.
Cameron Iron Works, Inc.
The Cleveland Pneumatic Tool Co.
Delco-Remy Div. General Motors Corp.
Eastern Air Lines, Inc.
Euclid Div. GMC
Fairchild Camera and Instrument Corporation
General Atomic Div. General Dynamics Corp.
Goodyear Aircraft Corp.
C. L. Gougler Machine Co.
Greenlee Bros. Co.
Hoover Tool & Die Co.
Hughes Aircraft Co.
The Hydraulic Press Mfg. Co.
I-T-E Circuit Breaker Co.
Kaiser Industries Corp.
Koppers Co., Inc.
Kurt Mfg. Co.
Librascope Incorporated
Lycoming—Div. of Avco Manufacturing Corporation
Manning, Maxwell & Moore, Inc.
Massachusetts Institute of Technology
Maytag Co.
Menasco Mfg. Co.



A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

A TYPICAL EXAMPLE OF JIGMIL PRECISION applied to the guided missile program

Mechanical Specialties Co. uses the JIGMIL Technique for machining pieces such as this 3500 lb. traversing-launching ring for guided missiles. Part is set-up on a Model 3B-96 JIGMIL. Critical machining involves boring 24 indexing holes on a 60" dia. with hole spacing of ± .0005; an interior hole pattern of 5 holes coordinated to a master within ± .00025; 30 additional holes in a 30" x 36" rectangular pattern to ± .001; accurate milling of locating pads and boring of 3 large critical bores to ± .001.

McKiernan-Terry Corporation
National Cash Register Co.
Norden-Ketay Corp.
Robbins & Meyers, Inc.
Rocketdyne Div., North American Aviation, Inc.
Rohr Aircraft Corp.
AC Spark Plug Division, General Motors Corp.
Sperry Farragut Co., Division of Sperry Rand Corp.
Stratos Div. Fairchild Engine & Airplane Corp.
Sundstrand Machine Tool Co. (Aviation Div.)
Sylvania Electric Products, Inc.
Utica-Bend Corp., a Subsidiary of
Curtiss-Wright Corporation

WILL YOU BE THE NEXT TO VISIT FAIR STREET

Our newest catalog
will help you decide.
May we send it?

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

FERNDALE • DETROIT 20

Looks Can Deceive...

Many have tried . . . *yet*

3 TYPES

REGULAR MODEL

Shown actual size. Adaptable to all tool posts, height and surface gages without need for cumbersome, error-producing attachments.

PERPENDICULAR MODEL

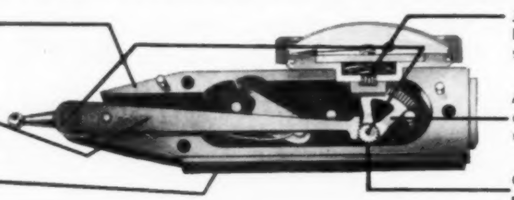
Specially designed for use on jig borers and in other awkward positions.

NON-MAGNETIC MODEL

Non-magnetic construction for use on magnetic chucks, and other magnetic fixtures. Attractively finished in natural brass.

WHY the Testmaster is so Amazingly accurate

Its Movement is designed and built by the world's foremost gage specialists



Rigid case construction maintains proper alignment of Movement.

Rigid steel lever provides faithful transfer of point motion.

Precisely machined dovetail slides at bottom and end offer choice of attachment location.

Jeweled bearings throughout assure low friction operation and maximum sensitivity.

Accurate crown gear provides simple, direct, low friction transfer of lever movement to hand . . . *and uniform wear.*

Gears are precision hobbed for maximum Accuracy.

HARD CHROMED, PRECISION INDEX POINTS

Tungsten tipped points are also available for extra durability.

Index Point locks in place but is easily removed for replacement. 180° swivel of Point permits wide choice of instrument positioning.

NEW

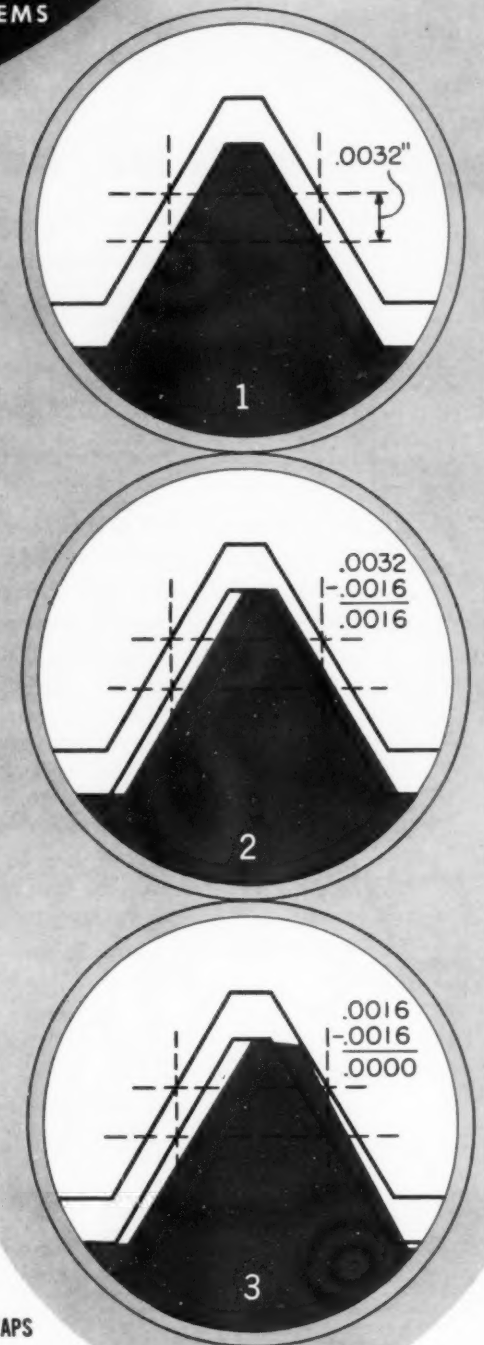
LONG RANGE HIGH MAGNIFICATION TESTMASTER

Eight New Models — .0005″ and .0001″ Graduations, Horizontal and Perpendicular Styles, Regular and Large 1½″ Diameter Dials — many other features. **Ask for New Brochure.**

 FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-6-33

TROUBLE-SHOOTING
THREADING PROBLEMS

lead error



WHAT IT COSTS

Lead error is bad enough by itself. But, when combined with other factors, it's worse. For instance, consider what happens to this 3/4-16 Class III thread.

Chart 1. shows a good thread which allows the full tolerance of .0032" on the pitch diameter for chaser wear. The same thread is shown in chart 2., but this time with a slight lead error of .0009" in 3/4 of an inch of thread length. *The working tolerance is now cut in half.* Chart 3. shows what happens when just a fifty-nine second (less than one degree) flank angle error is added to that small lead error. *There now is no working tolerance left.*

From this simple illustration, it is evident that the closer you can maintain lead and flank angle, the more size adjustment you have left for chaser wear. In other words, perfect lead and thread form present maximum provision *for better threads at lower cost.*

HOW TO PREVENT IT

Lead and thread form error are never a serious threat with J&L threading tools. Here's why:—

1.) The thread form is ground on the chaser after hardening, removing the possibility of heat-treating distortion.
2.) The thread form is ground on the exact helix angle for the diameter and pitch of thread to be cut.
3.) The non-cutting teeth on the chaser form a precision lead nut to lead on to the work.
4.) The die head has the rigidity and "beef" to hold the chasers in proper position in spite of cutting pressures.

OUR OFFER

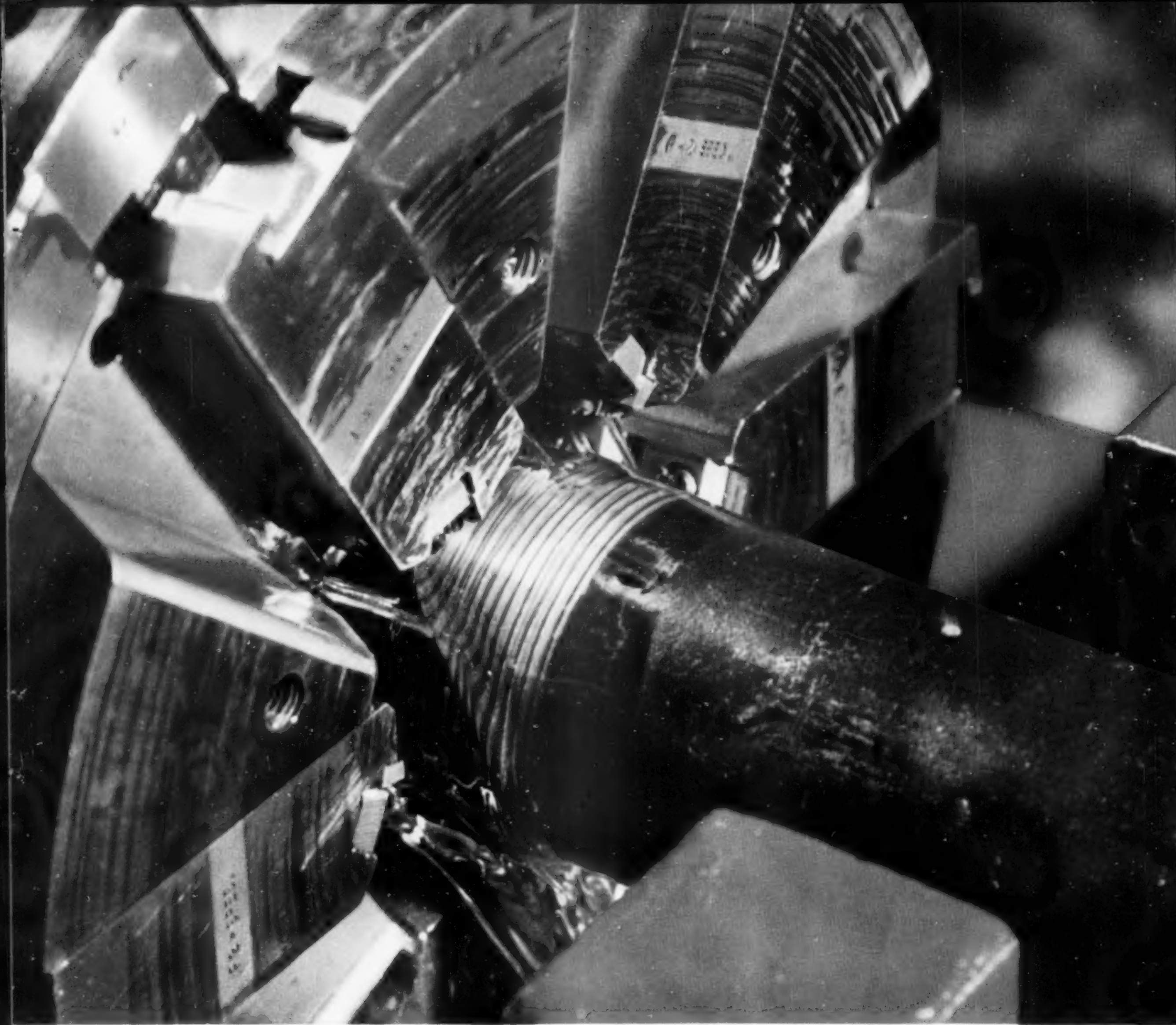
We solve threading problems. May we tackle some of yours? Send them in—no obligation.

TANGENT & RADIAL DIE HEADS · COLLAPSIBLE & SOLID ADJUSTABLE TAPS
also
Self-opening Stud Setters · Modern-Magic Chucks and Collets
Precision Boring Machines

JONES & LAMSON

THREAD TOOL DIVISION

Jones & Lamson Machine Company, 518 Clinton Street, Springfield, Vt., U. S. A.



Tubular parts—*On even thin-walled tubes from ½ to 2-inches OD, splines and serrations can now be quickly and inexpensively Roto-Flo cold formed.*

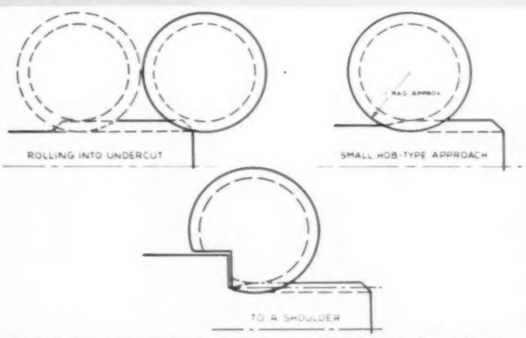
Long splines—*can now be cold rolled on solid as well as tubular parts. 30° or 45° PA tooth forms can be made with this low-pressure method and axially fed parts.*

Announcing a NEW ROTO-FLO METHOD

Now the ROTO-FLO chipless process that cold forms toothed parts faster at lower cost is extended to a broader range of parts. The development complements present Roto-Flo equipment. *Write for details!*

- **–for spline rolling tubular parts**
- **–for splines of any length**
- **–with versatile lower cost tooling**
- **–economical for shorter runs**

Lower-cost tooling—*Cylindrical forming racks reciprocate in opposed directions while a part is fed in axially. Racks are indexable to several settings for long life and lower tool inventories. No regrind costs are involved with these throwaway forming inserts.*



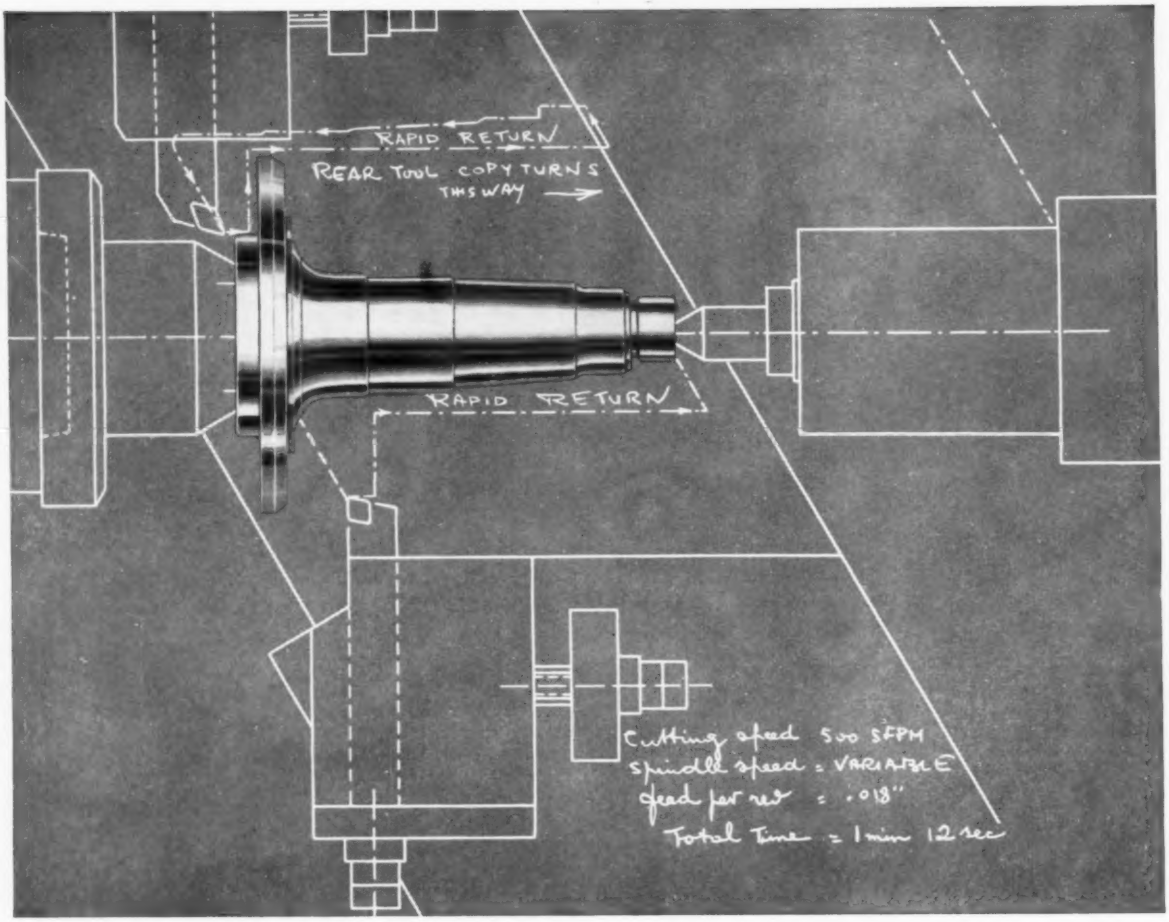
All kinds of parts—*are inexpensively splined or serrated with this versatile new Roto-Flo method. Notched racks can form full-depth teeth within ¼ inch of a shoulder. Parts having the same pitch diameter can be rolled with the same rack.*

May we have the Roto-Flo field engineer in your area show you how this new method can make your parts better.

MICHIGAN TOOL Company

from blank to finished gear

7171 E. McNICHOLS RD., DETROIT 12, MICH., U.S.A.
IN CANADA: COLONIAL TOOL CO. LTD.

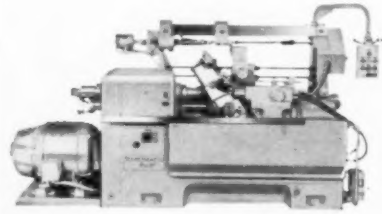


Without special tooling the Conomatic Pilot can copyturn a 90° reverse shoulder like this

With the Conomatic Pilot copying lathe, you can copyturn a 90° reverse shoulder with a single cross slide. Although this hydraulically-controlled multicycling lathe can be equipped with as many as two infeed slides and two cross slides, its ability to copyturn in reverse often makes costly special tooling unnecessary.

For example, the 90° reverse shoulder on the automatic transmission part shown above is copyturned in reverse by the rear tool on the 60° cross slide when the lathe's motorized template indexes after the front tool has completed its pass. Total time is 1 minute 12 seconds, with a gross production of 50 pieces per hour.

Write us today for a brochure giving details and specifications of the Conomatic Pilot—the world's most versatile copying lathe.



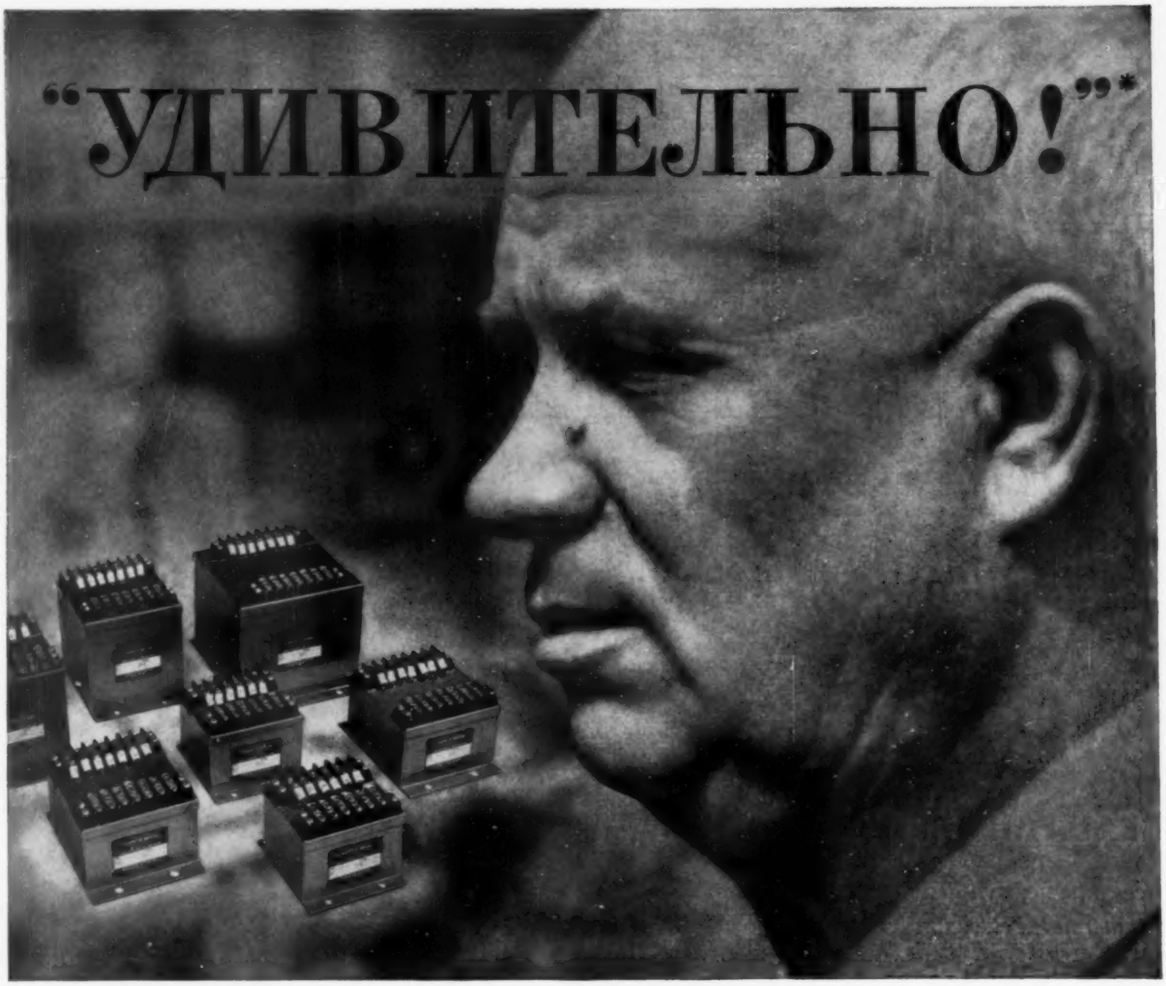
The Conomatic Pilot Model KU: A hydraulically-controlled multicycling copying lathe with piloted hydraulic feed that provides constant feed per revolution. Motorized rotating template provides up to four passes and four rapid returns or four additional passes in reverse. Adapted to completely automated loading and unloading.

Conomatic

CONE AUTOMATIC MACHINE CO., INC., WINDSOR, VT.

PILOT DIVISION

30 Rockefeller Plaza, New York 20, N. Y.



CONTROL is first! Now–one step static control with switching reactors

No wonder Nikita looks worried. CONTROL has taken the strain off Americah industry's pocketbook by cutting the cost of static control.

American engineers who want to make free use of power switching guided by digital logic can now take over, because CONTROL's standard line of switching reactors give freedom of design and economy never before available.

First, one-step static control with switching reactors is so easy to operate it can be put to work in everyday sequencing and switching problems involving either a-c or d-c loads. Auxiliary equipment is eliminated by the basketful. Gone are all the preamplifiers, special power supplies, information-sorting single purpose logic units, and power switching relays. CONTROL's one-step switching reactor does most of the job by itself.

Second, these units, in four nominal volt-ampere ratings of 15, 75, 150 and 300, have no relay contacts or moving parts to replace. Switching is by impedance change. Install them and forget them–no wear, no maintenance.

Third, each CONTROL reactor performs all logic functions –AND, OR, NOT, MEMORY and TIME DELAY–through its multipurpose control coils. Signal source is derived typically from limit switches, push buttons, or photo-cells.

Fourth, each unit has a 10,000:1 switching ratio under nominal supply voltage conditions. High inrush currents are handled without difficulty.

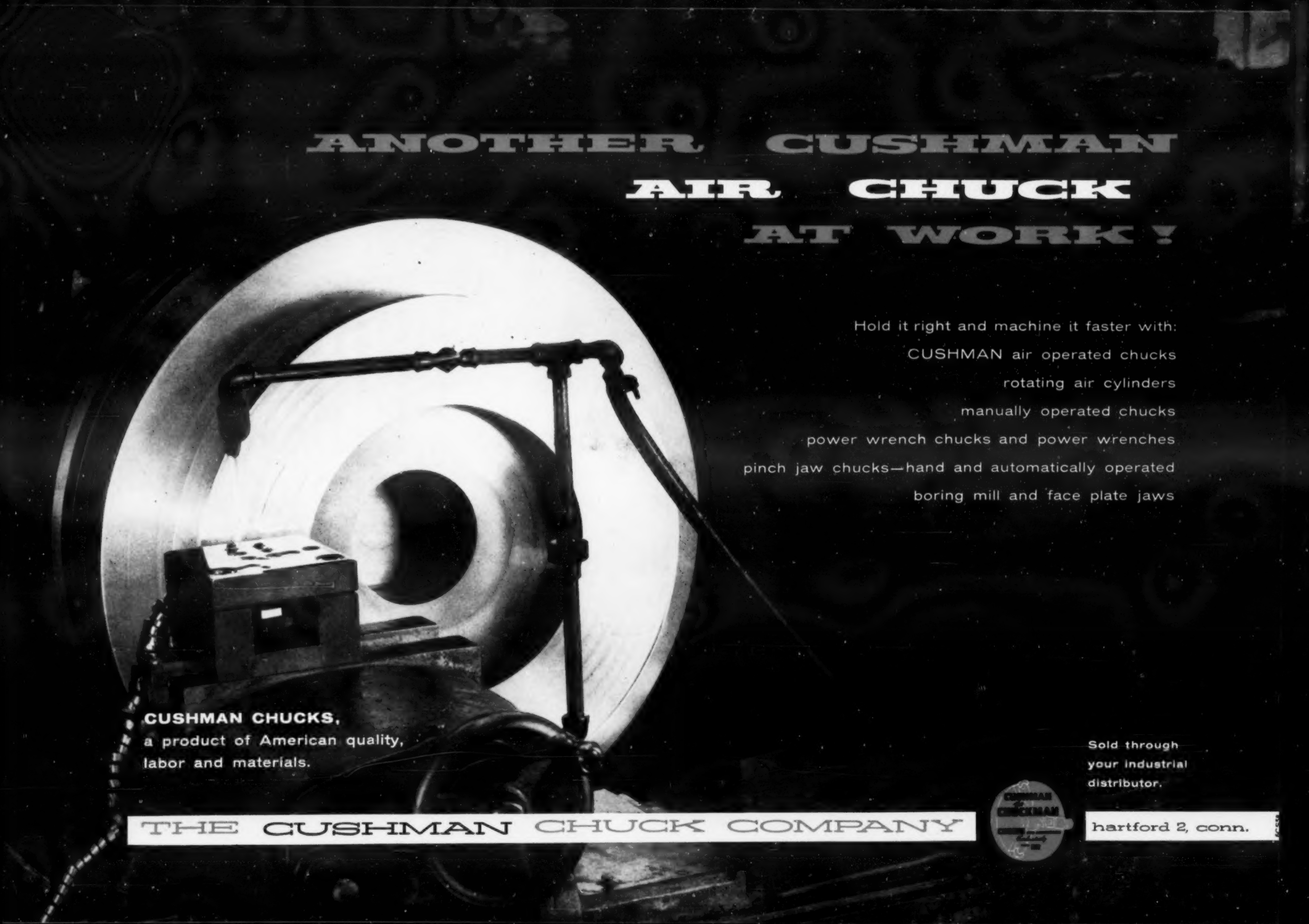
To learn how CONTROL reactors work, and how they'll fit your need for completely dependable, low-cost, versatile static control, write–and see why Nikita looks worried. *CONTROL, Dept.* **T-46,** *Butler, Pa. U. S. A.*

Reliability begins with CONTROL

A DIVISION OF MAGNETICS, INC.

**Expurgated translation. Heavens-to-Betsy!*

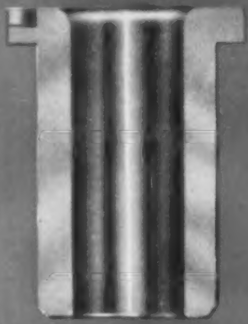
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-6-40


ANOTHER CUSHMAN
AIR CHUCK
AT WORK!
Hold it right and machine it faster with:
CUSHMAN air operated chucks
rotating air cylinders
manually operated chucks
power wrench chucks and power wrenches
pinch jaw chucks—hand and automatically operated
boring mill and face plate jaws
CUSHMAN CHUCKS,
a product of American quality,
labor and materials.
Sold through
your industrial
distributor.
THE CUSHMAN CHUCK COMPANY
hartford 2, conn.

for accuracy in your production
it pays to specify

UNIVERSAL DRILL BUSHINGS

In Universal you get the best. Machined from finest quality steel. Blended radius on the top-inside diameter helps prevent tool hang-up and breakage. 100% concentricity and hardness tests insure accuracy and uniform quality. Knurled heads provide a quick, sure grip.



superfinish bores lengthen tool life

The superfinishing of Universal Drill Bushings is an important factor in keeping tool and bushing wear to a minimum—especially in close tolerance work.

Standard sizes and lengths in stock for immediate delivery. Contact the office nearest you—Universal Engineering Sales Co., 1060 Broad St., Newark 2, N. J.; 5035 Sixth Ave., Kenosha, Wis.—or our home office.

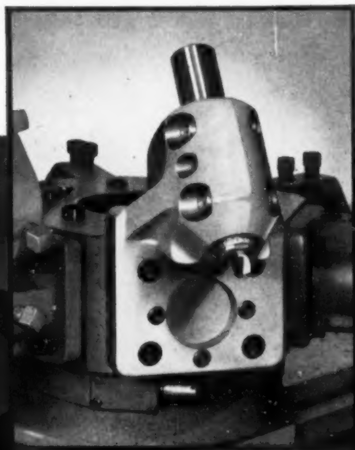
Write for your copy of our new 98 page catalog describing Standard Collet Chucks, Floating Collet Chucks, Boring Chucks, "Kwik-Switch" Tool Holders, Mikro-Lok Boring Bars, Standard Drill Bushings, Universal Index Plungers and other Universal products.

UNIVERSAL ENGINEERING COMPANY | FRANKENMUTH 3, MICHIGAN

192

new microbore turning heads feature speed, ruggedness, precision!

Flange Mounting Heads mount directly on the face of the turret providing extreme rigidity.



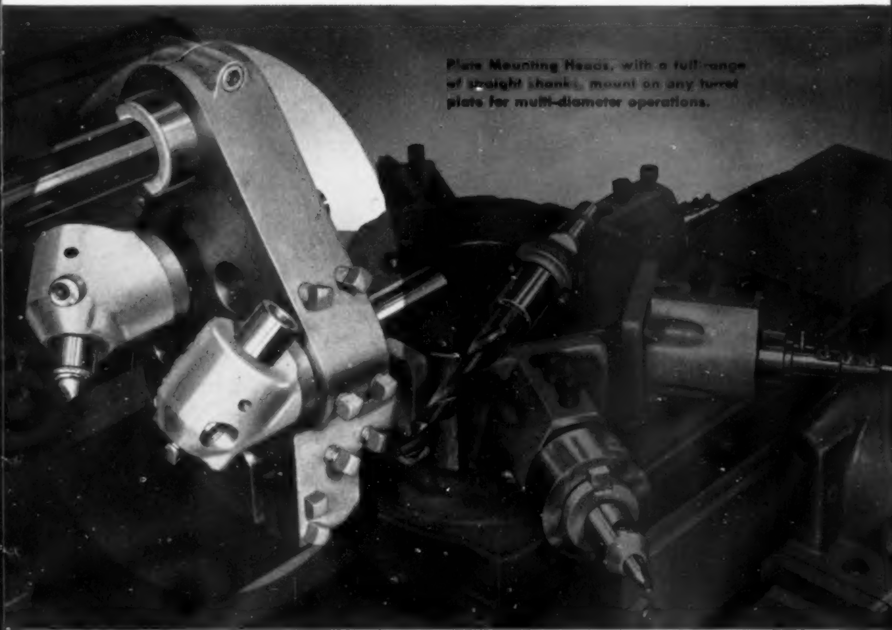


Plate Mounting Heads, with a full range of straight shanks, mount on any turret plate for multi-diameter operations.

Shank Mounting Heads permit quick, easy mounting in the turret and maximum versatility.

STANDARD, GENERAL PURPOSE FOR ALL HORIZONTAL TURRET LATHES!

Rugged, rigid and adjustable in seconds, these new general purpose turning heads perform a variety of single and multi-diameter operations repetitively with unfailing accuracy. Microbore's exclusive micrometer vernier adjustment provides a fast, accurate means of setting the tool point over a wide working range. *0" to 4" for Shank or Flange Mounting Heads. 0" to machine capacity for Plate Mounting Heads.* Extreme rigidity throughout permits heavy stock removal while holding to closest tolerances. This combination of speed, ruggedness and precision reduces downtime, increases accuracy of the end product. Write for complete information.

DEVLIEG MICROBORE® SYSTEM

DE VLIEG MICROBORE • DIVISION OF DE VLIEG MACHINE COMPANY

2720 West Fourteen Mile Rd., Royal Oak, Michigan

New Dow epoxies feature "lens clear" liquid resin

Dramatic evidence of the striking clarity and purity of Dow Epoxy Resin 332—unique member of Dow's new line of liquid epoxy resins—is shown in the illustration above. The magnifying lens was actually cast from this new water-clear resin. In addition to improved clarity and uniformity, DER 332 has very low viscosity, longer pot life and greater heat resistance than conventional epoxies.

Also available, for formulations where absolute purity is not so important, are Dow Liquid Epoxy Resins 331 and 334.

Dow's position as a basic producer of all epoxy raw materials assures top quality control and a narrower range of specifications. It will also enable Dow to introduce, in the near future, a complete line of solid epoxy resins and a new line of polyfunctional liquid epoxy resins outstanding in high temperature service.

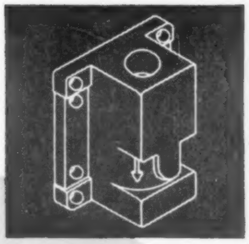
Prompt delivery of these three Dow Liquid Epoxy Resins can be made in drums, truck or tank car lots. For more information contact your nearest Dow sales office or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Coatings Sales Dept. 225M-1.

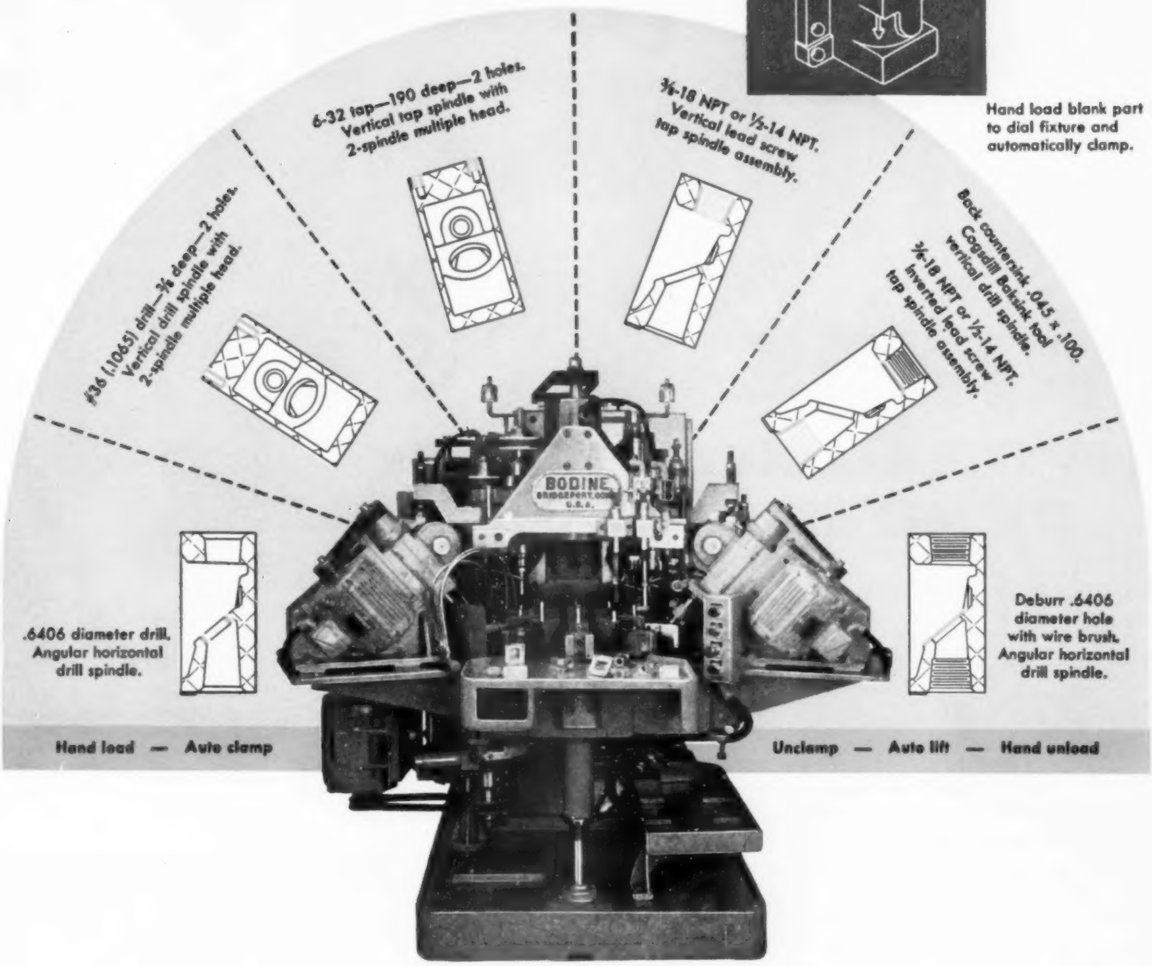
EPOXY

YOU CAN DEPEND ON DOW

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-6-46

Bodine case history no. 46





Good way to hold a winning hand

in competitive manufacturing.

This major manufacturer of automatic control equipment has used cost-reducing Bodine Basic Machines and tooling methods for many years.

The interesting new Bodine unit shown above went in to replace another machine . . . to include MORE OPERATIONS, performed at a FASTER RATE.

The new machine features recently-developed Bodine reversing motor-driven lead screw spindles . . . one vertical and one inverted. The valuable versatility of Bodine tooling with combinations of vertical, angular and inverted spindles is clearly demonstrated.

This is also an example of how advanced Bodine tooling is constantly stepping ahead of production demands, even among present Bodine users. In all cases, such tooling is readily adapted to present Bodine Basic units, an important cost-advantage users of our equipment enjoy.

If you have a part you would like to produce better at lower cost, send us a sample and prints for analysis. No cost or obligation. Write Dept. TE-6.

1BD58

MATERIAL and PART: Zinc die-cast valve body.

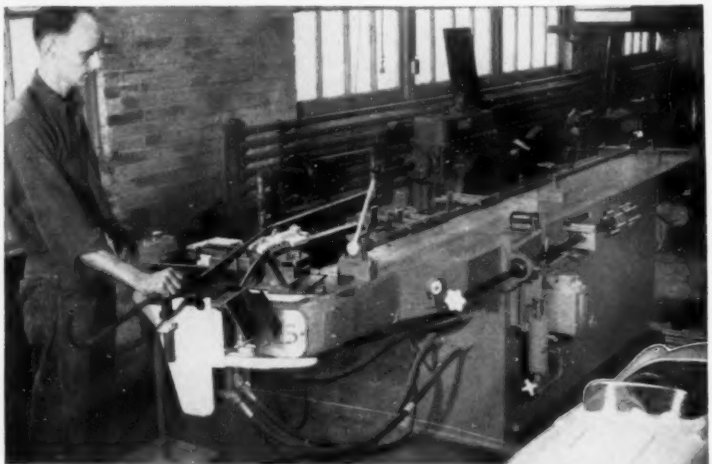
PRODUCTION: 15 complete pieces per min.; 6000 operations per 50-min.hr.

THE
Bodine
CORPORATION
BRIDGEPORT 5, CONNECTICUT

AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

NET PRODUCTION

840 Bends Per Hour



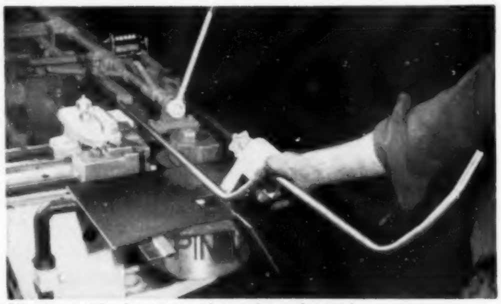
With

PINES HYDRAULIC BENDER

Over-all view of Pines Size ¾ Bender at Flexsteel Spring Division used for outside job work as well as for their own manufacturing needs. Application illustrates setup for bending long side members for toy Corvette car.

Automatic Cycling Speeds Job Work for Flexsteel Spring Division - Dubuque, Iowa

Here's another typical example of fast, efficient production bending illustrating the outstanding advantages of automatic cycling, a standard feature on most Pines machines. Flexsteel Spring Division, Northome Furniture Industries, Dubuque, Iowa, used this set-up to produce frames for a toy Corvette car from ⅝″ 18-gauge welded steel tubing. Records show that over a period of three months, net production on workpiece illustrated averaged 140 pieces (840 bends) per hour. On this job requiring six bends of the same radii (1 13/16″), the operator simply positions the tubing for each bend and presses the forward button. Pre-set indexing stops automatically control the angle for each bend in sequence while the operator rapidly positions the workpiece. Automatic cycling saves valuable production time and accounts for the high efficiency rate maintained.



Simple positioning gauge determines plane of each bend. View shows position for making sixth bend for right-hand frame member. Both right-hand and left-hand members are produced on same setup.

Accuracy Maintained at High Production Speeds

Another well-known advantage of Pines machines is their ability to maintain accuracy. Tolerances of .030 to .040 at several check points are commonly held without difficulty, simplifying welding, assembly, or other fabricating operations. In addition, all Pines machines are designed for small radius bending with mandrels, as well as for bends of the type illustrated not requiring mandrels. For accuracy and efficiency, it will pay you to specify Pines.

WRITE FOR *Free* DATA SHEETS

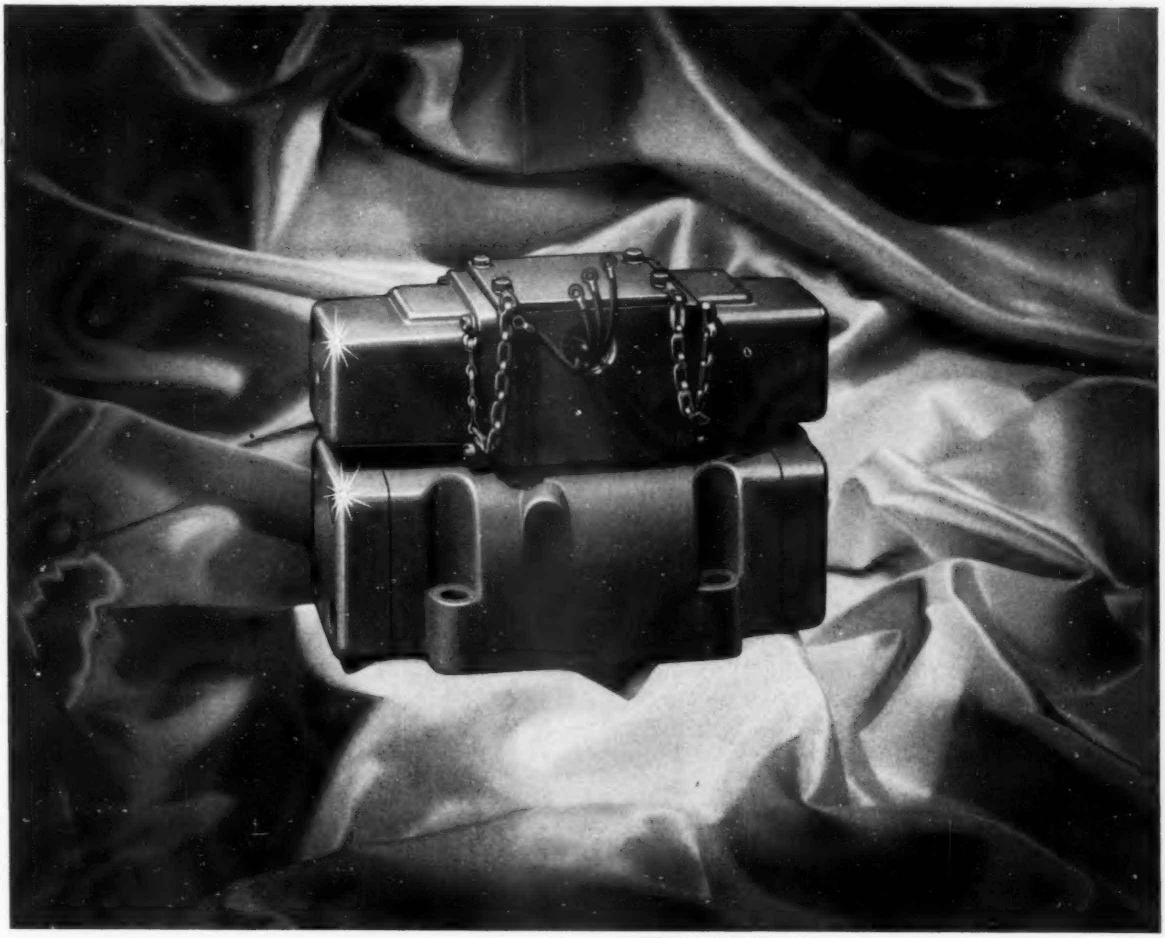
Ask for up-to-date case study material on production bending the "Pines-Way." Full information available, including tooling and setup data used for producing steel channels, rods, extrusions, pipe, and tubing. Or for assistance on any job, ask for a Pines sales engineer to call.

PINES ENGINEERING CO., INC.

Specialists in Tube Fabricating Machinery

693 WALNUT • AURORA, ILLINOIS

PRODUCTION BENDING • DEBURRING • CHAMFERING MACHINERY



Illustrated—New 9700 Series
Piggy Back Hydraulic Control Valve
Meets J.I.C. Standards

the ultimate in hydraulic valve design

FREE SEND FOR THE "LOGAN CALCULATOR"
A gift to you from Logansport Machine Company upon request.

MEMBER: Natl. Mach. Tool Builders Assn.; Natl. Fluid Power Assn.

LOGANSPORT MACHINE CO., INC.
839 CENTER AVENUE, LOGANSPORT, INDIANA

PLEASE SEND COPY OF CATALOG:

- ☐ 100-1 AIR CYLINDERS
- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-5-1 ULTRAMATION CYLINDERS
- ☐ 51 PRESSES
- ☐ FACTS OF LIFE
- ☐ 62 SURE-FLOW PUMPS
- ☐ 200-1 HYD. POWER UNITS
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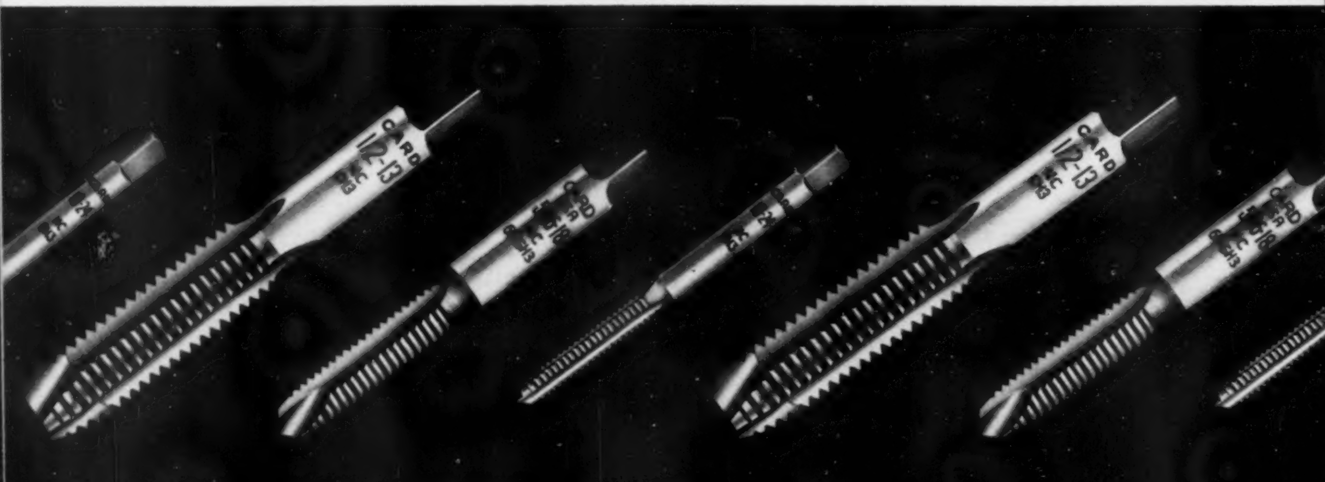
ADDRESS __________

As these electric light bulbs are uniform



...So Card special purpose taps are uniform, too


If you use drills as much
as rivets are used on airplanes . . .


This brand cuts down your drill
usage, production time and costs!
UNION

a complete line

is the shortest distance to top production

The shorter the distance the less the cost. Butterfield taps save time, help you improve product quality and cut production costs.

There are Butterfield warehouses in Chicago, Cleveland, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

See your Butterfield Distributor for precision-made drills, reamers, taps, dies, counterbores, cutters, end mills, hobs and carbide tools.

36B.8.10

BUTTERFIELD

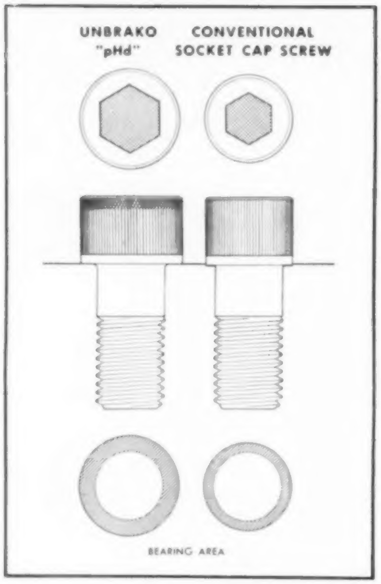
. . . the cutting tools that make the most of your product

BUTTERFIELD DIVISION, UNION TWIST DRILL COMPANY, DERBY LINE, VERMONT


NORTON

NEW UNBRAKO socket cap screws with *pHd**

Another Unbrako first providing higher reliability through greater usable fastener strength



pHd stands for "proper head design"—a factor in higher product reliability

Enlarged bearing area surface of new design increases holding power of screw up to 2⅓ times. The new design is the end product of extensive study of bolt-bearing stresses by SPS Laboratories. This research was sparked initially by the relatively high incidence of fastener failures, later traced to fatigue, in certain cap screw sizes. These sizes proved to have head diameters and other design characteristics which, though standard for many years, could not utilize the full strength of the screw.

UNBRAKO pHd—UP TO 134% INCREASE IN USABLE STRENGTH

The head size increase, a maximum of only 17% in the larger sizes, increases usable fastener strength as much as 134%. In tension bolting—primary application of socket cap screws—this means greater clamping force and longer life under dynamic loads. The heads, enlarged on 5/16, 7/16, 9/16, ⅝, ¾, ⅞ and 1 in. body diameters, also prevent the screw head from indenting the material being assembled—a fault that normally reduces, and sometimes completely dissipates, the vital preload or tensile stretch that keeps the screw tight and prevents fatigue failure. The larger head diameter of the new UNBRAKO pHd also provides room for a bigger wrenching socket where required and this, in turn, makes tightening to designed tensile preload easier and safer.

SPS enlarged the head diameters to hold the bearing stress to 80% of the axial tensile load on the screw. The bearing stress of a screw loaded to 100,000 psi would be a maximum of 80,000 psi. Recommended installation torques to attain this initial tightening are substantially higher than for standard socket cap screws.

COMPARISON OF UNBRAKO pHd AND CONVENTIONAL DESIGN

Each size can now be utilized with equal reliability. The bearing stress is consistent from size to size in the new UNBRAKO pHd socket cap screws.

SCREW SIZE	HEAD DIAMETER (in.)		BEARING AREA (sq. in.)		LOAD TO INDENT IN CAST IRON (lb.)		% INCREASE USABLE STRENGTH	TIGHTENING TORQUE (lb.-in.)*	
	Old	pHd	Old	pHd	Old	pHd		Old	pHd
¼	.375	.375	.041	.041	3,280	3,280	—	165	180
5/16	.435	.468	.047	.072	3,760	5,760	54	325	360
⅜	.560	.560	.102	.102	8,150	8,150	—	600	660
7/16	.623	.656	.116	.148	9,270	11,800	27	1,000	1,040
½	.748	.748	.188	.188	15,000	15,000	—	1,450	1,590
9/16	.810	.843	.209	.247	16,700	19,700	18	2,050	2,270
⅝	.873	.973	.203	.305	16,200	24,400	51	2,900	3,190
¾	.998	1.125	.223	.432	17,800	34,600	94	5,050	5,600
⅞	1.123	1.312	.254	.594	20,300	47,500	134	8,000	8,900
1	1.310	1.500	.364	.785	29,100	62,800	116	10,550	13,600

*Normal recommended seating torques for unplated screws, fine threads

hiRf
High Reliability factor

Research at SPS is realistic, for it faces the fact that industry is always seeking structural and mechanical components with higher and higher standards of predictable performance. By installing SPS high reliability fasteners in your assemblies, you increase overall product reliability.

"High Reliability" is a booklet just published by SPS. Write for your copy today.

ADVANTAGES OF THE NEW UNBRAKO pHd SOCKET HEAD CAP SCREWS

- **Miniaturization.** Space and weight-saving design through use of smaller diameter or fewer fasteners. The 180,000-200,000 psi of these fasteners can be utilized to greater advantage.
- **Reduction of fatigue failure,** because these cap screws assure the necessarily high preload. Lack or loss of it is responsible for some 75% of threaded fastener failures.
- **Fewer loosened threaded fasteners** under shock or vibration.
- **Elimination of washers** under the heads of cap screws in many applications where they are now used to increase the effective bearing area.
- **Minimization of effects of oversized holes** on the head bearing area and resulting increase of holding power.

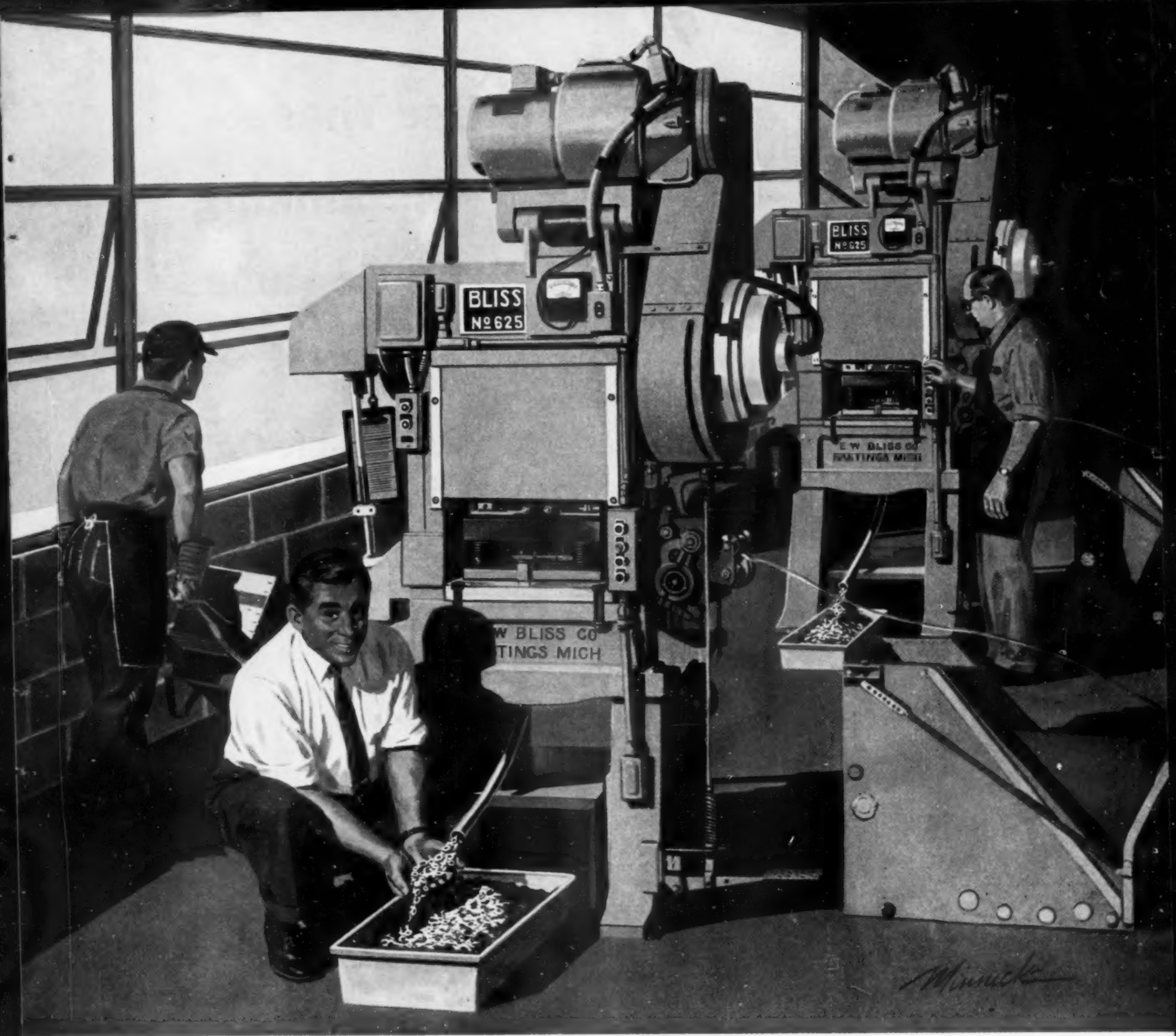
The new UNBRAKO pHd socket head cap screw is now available through all authorized industrial distributors at no increase in price. Specify UNBRAKO pHd when you order. For technical data and specifications, send for Bulletin 2406. Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 37, Pa.

We also manufacture precision titanium fasteners. Write for free booklet.

SPS **Jenkintown • Pennsylvania**

Standard Pressed Steel Co. • The Cleveland Cap Screw Co. • Columbia Steel Equipment Co. • National Machine Products Co. • Nutt-Shel Co. • SPS Western • Standco Canada Ltd. • Unbrako Socket Screw Co., Ltd.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-6-54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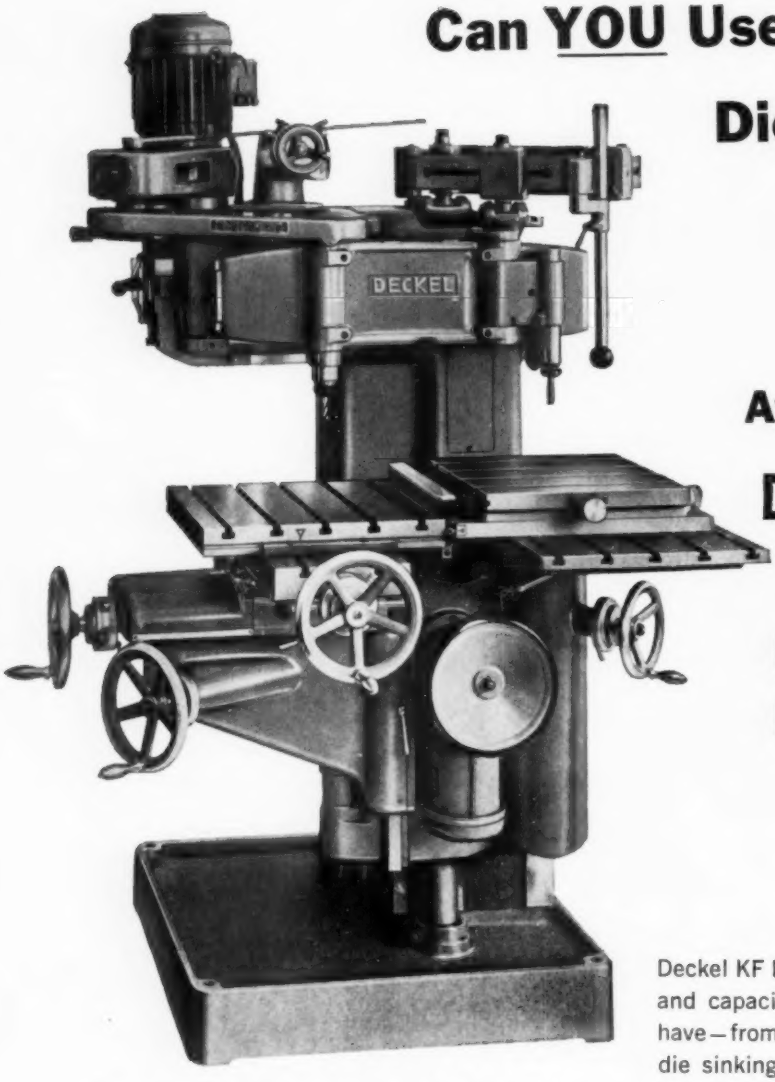

DECKEL

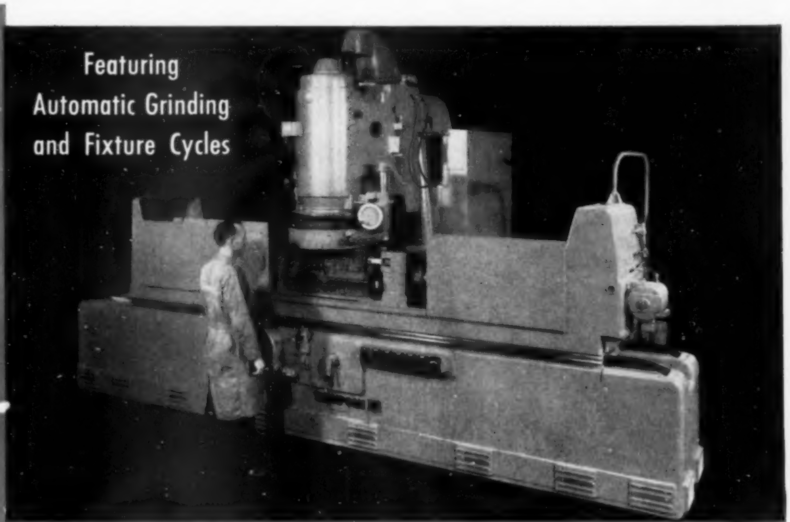
THOMPSON handles the toughest production jobs... *fast and accurately...*

with

THE VERTICAL SPINDLE SURFACE GRINDER

SPECIFICATIONS

Size:	18" x 18" x 62"
Wheel:	22" Segmental
Production:	30 blocks per hour
Total Stock Removal:	.010"



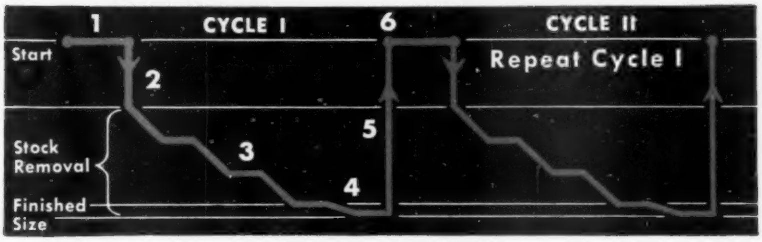
Shown above is the latest Thompson vertical spindle machine grinding the diesel engine cylinder blocks of a leading truck manufacturer. To meet the demand for fast, continuous production, both the fixture and grinding cycles are automatic and are interlocked to prevent accident. A separate hydraulic power source operates the single place fixture which locates the cylinder block on the main bearing holes.

Since any variations in stock removal would affect the compression ratio of the engines, constant accuracy is controlled throughout the grinding cycle. The operator merely sets wheel contact with the work and automatic operation begins.

Thompson vertical spindle surface grinders are made in various types and sizes to meet all job requirements. All machines of 40 inches and up in work length are equipped with the Hydra-Cool Hydraulic System*—the exclusive Thompson feature that eliminates all heat distortion throughout the machine.

*Pat. Applied For

MACHINE CYCLE (Total Stock Removal .010")



C Y C L E I

1. Load work piece into fixture and start table cycle.
2. *Manually lower grinding wheel to contact work piece.
3. Automatic downfeed of wheel occurs at each table reverse to remove .010" stock.
4. Spark out to final size with table moving to start position.
5. *Manually elevate grinding wheel to starting position and release work piece in fixture.
6. Table automatically stops.

**Can be furnished as automatic functions.*

Thompson SURFACE GRINDERS

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

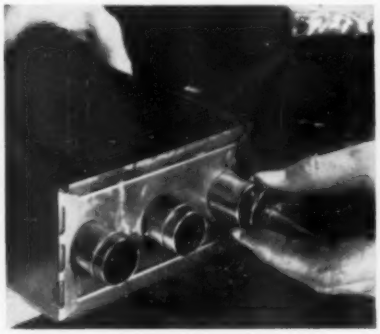
"Keep Thompson in mind for that daily grind"

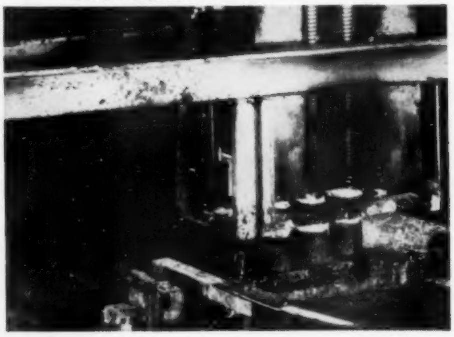
 FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-6-59

1 EASY-FLO preform ring is slid over header tubes.

2 Operator fluxes bank of assemblies prior to heating.

3 Assembly is heated by gas-air burners; heating time: 50 seconds. Note capillary action of alloy; thorough penetration makes strong, leakproof joint.





4 Components of header box; ring is preplaced.

5 Header box under heat; time: 46 seconds.

6 Brazed unit. Note neat, clean fillet around base of tube fitting.

Embassy Steel Products **Cut Unit Labor Cost 50 Per Cent** with **Handy & Harman Silver Brazing**

START WITH BULLETIN 20

It tells you why and how high speed, strength and economy are inherent in silver alloy brazing. Gives information on joint design and brazing methods. A copy is yours for the asking.

Before Handy & Harman Silver Alloy Brazing came into Embassy Steel Products' production picture, these convector radiators were welded. Now, they are brazed with EASY-FLO 35 *using gas-air heat, and unit labor cost has been cut by 50 per cent. This includes cleaning, fluxing and assembling. Not bad, eh?*

Components involved in this big saving are cold-rolled steel header plates that are brazed to fin tubes and cold-rolled steel header boxes that are brazed to steel fittings. Both of these convector assemblies are used in residential heating units.

Preformed EASY-FLO .047 wire (.015 ID) is used for brazing the header plate and fins. Photographs describe the joining steps. Each assembly goes through a 50-second heating cycle.

The header box is made in three sizes—depending on the size of the coil assembly it fits. Average heating time for any size is 46 seconds. Two sizes of EASY-FLO are used: .047 and .062 wire. Switching from one size to another involves no change in assembly or heating setup. Add this to brazing's long list of production benefits and *subtract* it from production costs.

If all we had to talk about in this case was the reduction in production time because of brazing, we'd still have a strong story to tell. You'll notice that we've said nothing about joint strength, alloy cost, corrosion resistance, ductility and so on. We can, and if you'd like to know how these benefits can apply to what you're joining right now, all you have to do is ask us. We'll be happy to tell you.

Your No. 1 SOURCE OF SUPPLY AND AUTHORITY ON BRAZING ALLOYS

HANDY & HARMAN QUALITY SERVICE

HANDY & HARMAN

General Offices:
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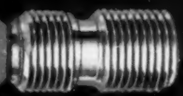
Distributors in Principal Cities

Here's
What
One
Government
Gage
Laboratory
Says

about **PIPE MACHINERY HILO SET PLUGS**



A well-known government gage laboratory recently reported on their study of our Hilo Thread Setting Plug Gages as follows:

"The setting plugs were used to retest several of the thread rings we had in stock. The results were enlightening. Some were rejectable because of worn flank; others were rejectable or borderline because of bell mouth.

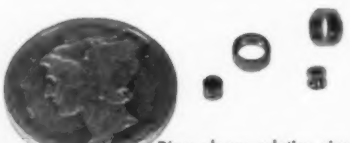
"The HILO Setting Plug is unquestionably sound and superior . . . a saving of many man hours by less skilled help for acceptance inspection and surveillance can be foreseen."

A word to the wise is sufficient. You, too, can employ no more positive method for setting your thread ring gages and other adjustable instruments for the inspection of male threaded parts than with Pipe Machinery Hilo Set Plugs.

Stop in and see us when you're in the Cleveland area.

THE PIPE MACHINERY COMPANY
29100 Lakeland Blvd.
Wickliffe, Ohio
Greater Cleveland

Can parts this small be barrel finished?



Dime shows relative size of typical bearing races.

Twin-barrel Almco Supersheen Model DBO-1A used by Miniature Precision Bearings to process tiny bearing assemblies. It's the ideal machine either for small lots of parts or large lots of small parts.

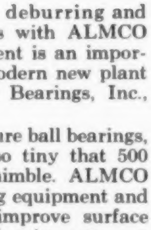
EMPHATICALLY, YES!
For example, precision deburring and finishing of small parts with ALMCO barrel finishing equipment is an important operation at the modern new plant of Miniature Precision Bearings, Inc., Keene, N. H.

M.P.B. makes miniature ball bearings, some with assemblies so tiny that 500 can be carried in a thimble. ALMCO precision barrel finishing equipment and methods are used to improve surface finish on the inner and outer races, as well as removing burrs, sharp edges and machining lines.

Production usually runs from 1,000 to 4,000 parts per load, and occasionally at from 5,000 to 15,000 parts per load.

SEND FOR FREE 52-PAGE BOOK . . .

Modern precision barrel finishing processes completely described. 52 pages of facts, photos, data and cost comparison charts. Send for your free personal copy today.



All told, millions of parts annually are finished the ALMCO way at Miniature Precision Bearings!

If you have a finishing problem with your parts, small *or* large, perhaps ALMCO has the answer. It's easy to find out. Just write us on your letterhead asking for an ALMCO sales engineer to call. He will arrange for your product parts to be run through detailed sample processing to determine what combination of machine, compound, media, cycle, etc., will produce the results you want, at lowest possible cost.

Or, if you prefer, send sample parts and specifications on results desired direct to ALMCO's main laboratory at Albert Lea, Minnesota.

ALMCO

QUEEN PRODUCTS, INC.

186 Marshall Street • Albert Lea, Minnesota

Subsidiary of KING-SEELEY Corporation

Sales and Engineering Offices in Chicago, Detroit, Los Angeles, Newark, New Haven and Philadelphia

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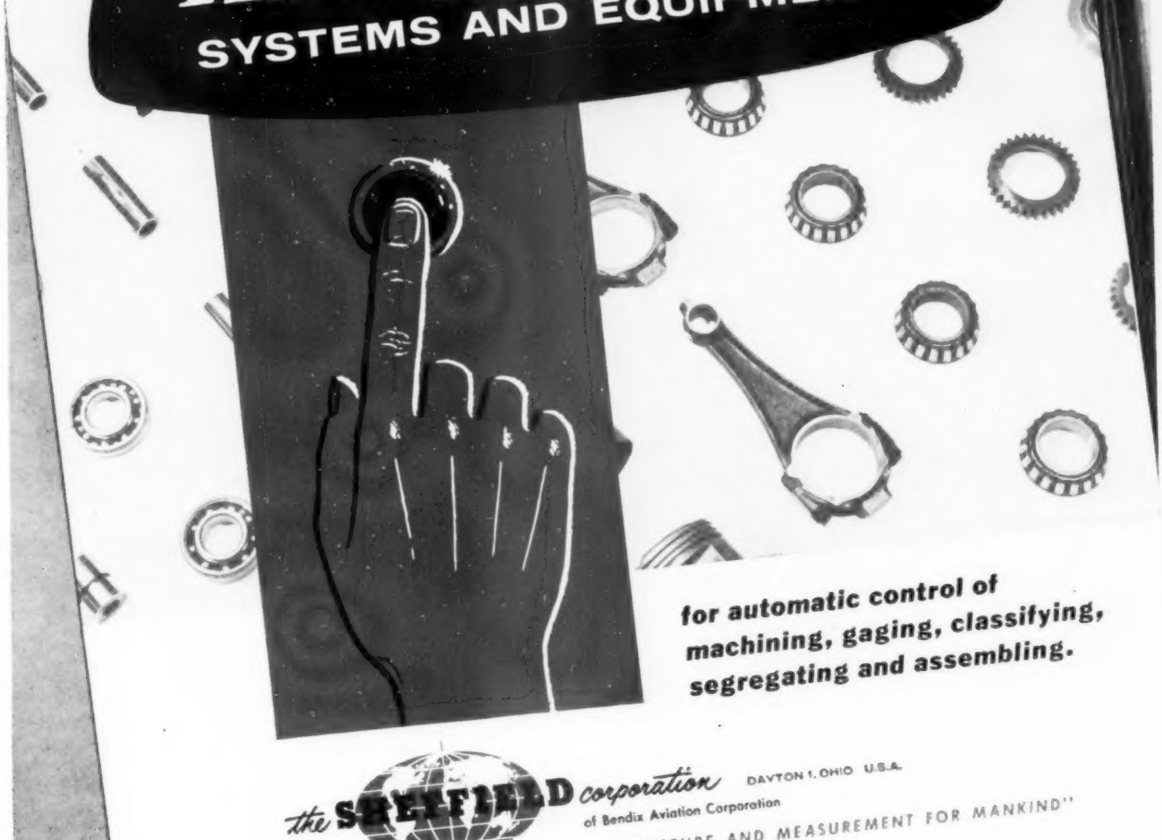
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for automatic control of machining, gaging, classifying, segregating and assembling.
the SHEFFIELD corporation DAYTON 1, OHIO U.S.A.
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What that Red Ring MEANS

That Red Ring on a gear shaving cutter means it was made by an organization which has more experience and success in this field than any other in the world.

That Red Ring marks the product of engineers and shop men who devote all their working time to these CUTTERS – nothing else.

That Red Ring reminds the user that these specialists are ready to help him get off the hook if he runs into a troublesome gear problem.

That Red Ring says "This cutter is designed and manufactured to deliver the best possible shaving performance."

Write for bulletin CR 56-10

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ORIGINATORS OF ROTARY SHAVING
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NATIONAL BROACH & MACHINE CO.

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WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

7968

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-6-64

Why the Die Designer Prefers PRODUCTO Die Sets

He can specify Producto with complete confidence

The die designer likes to specify Producto die sets on his blueprints because they are a nationally-accepted "brand." They're easy to get anywhere... and delivery is prompt.

He favors Producto because he knows he never has to compromise his die design. Even if the die layout is a little unusual, he will be able to select a die set to accommodate it from Producto's wide range of thicknesses and styles.

He also knows Producto has the equipment that can cut his tooling costs by letting him adapt his sets to a more economical *basic* design. Only Producto offers him complete foundry, pattern-making, welding and machining services for his special requirements.

The die designer recognizes Producto's Qwik-Fit Guide Pins as an important new feature that die makers want. He specifies them because they save up to 75% of the time normally required for die set assembly and disassembly.

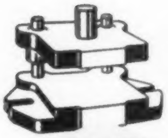
The die designer likes to use Producto's new catalog, the industry's most practical tool. His die layout is simplified when he uses Producto die set templates. And Producto provides him with cost-saving ideas in the DIE SET DIGEST.

Most important, he can depend on *consistent* Producto die set accuracy to transfer from the drawing board to the press the precision and ingenuity of his die design.

Yes, the designer has found that Producto die sets justify his confidence in specifying Producto. You will, too.

TWO FREE AIDS to more economical, efficient use of die sets are available from Producto. All-new CATALOG NO. 11 makes ordering and selection job easy. DIE SET DIGEST gives valuable tips for designers, builders and users of dies. Write for them today.

THE PRODUCTO MACHINE COMPANY
930 Housatonic Ave., Bridgeport 1, Connecticut



PRODUCTO

Wherever die sets are used

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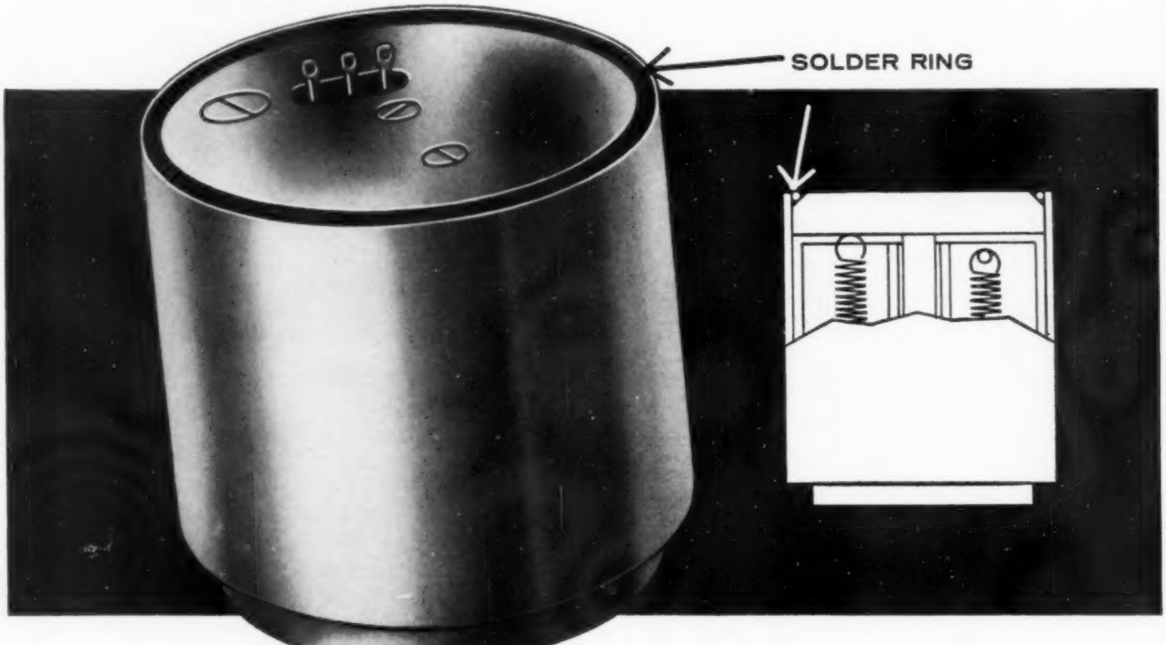
PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

Precision soldering
7 Times Faster...
with TOCCO* *Induction Heating*



When G. M. Giannini and Co., Inc., Pasadena, California, switched from old-fashioned methods to TOCCO Induction Heating they increased production of these high-precision accelerometers from 4 to 30 per hour—with a commensurate *decrease* in production costs.

Here's what a Giannini official has to say about the TOCCO installation: "Prior to using TOCCO for this purpose, we had tried soldering irons, normal torches, resistance sealing, and even threaded screw fittings, with uniformly poor results. Essentially, the TOCCO unit has permitted us to build, in production quantities, oil-filled hermetically sealed units that could not be produced in any other way."

Whether your production bottleneck involves soldering, brazing, heat treating or heating for forming it pays you to investigate TOCCO as an economical way to do it better, faster and at lower cost.

JUST PUSH A BUTTON **TOCCO**

*Trade Mark Reg. U.S. Pat. Off.

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today— NEW FREE Bulletin

The Ohio Crankshaft Co. • Dept. G-6, Cleveland 5, Ohio

Please send copy of "Typical Results of TOCCO Induction Brazing and Soldering".

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There's Nothing So Permanent As Changes

Your newly elected officers and directors will lead us in the 1958-59 year of changing times. This new leadership will have new ideas and programs suitable to the times and will carry to successful completion the programs that are now in process.

One program that should be considered perpetual is: Service to our members. We must help them increase their knowledge so that they may be able to serve their profession in a greater capacity and also increase their standard of living. Increased knowledge, creative thinking and organization can assist greatly in the strengthening of one's immediate community and our country.

This is an appropriate time to offer aid and contribute ideas to your newly elected executives so that you may assist in the completion of every worthwhile program. Perhaps in this way you can help shorten the so-called recession and help business in general.

As one of the 40,000 members of ASTE, I have the greatest confidence in the newly elected officers and directors, who have just taken office, and who will give so much of their time and energy to the successful operation of the society.

At this time, I would like to pay tribute to those who made the high honor of president possible for me. Any measure of success or credit during the past year should go to the members, directors, officers and headquarters' staff who have so ably assisted me.

It was a privilege and an honor to serve as your president.

H E Collins

IMMEDIATE PAST PRESIDENT
American Society of Tool Engineers

reliability requirements for tomorrow's COMPETITION

By H. Thomas Hallowell, Jr.
President
Standard Pressed Steel Co.
Jenkintown, Pa.

Greater reliability—and greater productivity—are the keys to success in our competitive economy. The author, who is president of the American Standard Association, defines the all-important role of tool engineers in industrial progress during the coming years.

We progress as individuals, as companies and as a nation when we produce more useful goods and services per hour of human effort. In the atmosphere of our American competitive way of industrial life there will be and must be a continuing trend to increase the over-all productivity of our private enterprise system. This improvement applies to our homes, our plants, offices and, last but not least, to our country's defense.

Progress in business means finding needs or wants—then filling those needs in a satisfactory and economical manner. Management must be constantly alert to the needs and wants of the consumer. The link between management and the consumer is the tool engineer, who translates ideas into tangible goods by prompt, effective and economical action—because, without a tool, nothing can be produced. The tool engineer is responsible for making products for more people at lower cost. And may I add, these products must have the proper degree of reliability.

Reliability must be a new way of life in industrial America. It must start with the tools and components we use and carry through our production at all levels, in all places. Our future progress will depend on your attitude as a tool engineer in conceiving, designing, tooling and building reliable products. Our future production must outperform today's in all respects and we still must turn out goods at a cost the consumer can afford to pay.

Too often, production-line thinking is primarily concerned with the cost factor, while satisfactory product performance is neglected. The American consumer is now stuck with a twenty billion dollar a year repair bill. He is begining to rebel, to demand reliable products—and I don't blame him.

To have reliability, the things we make and build must work and do the job for which they were intended. An organization must furnish goods and services which satisfy the customer—the one who pays the bill. We simply cannot afford to make or

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From a talk presented at the Philadelphia Day Luncheon, ASTE Annual Meeting.

The link between management and the consumer is the tool engineer . . . because, without a tool, nothing can be produced.

buy products that give trouble in use.

The reliability of your production setup is the multiplication product of the individual reliability factors of each of the components which are found in the operation. Take a simple die in a punch press—the bottom die shoe—the top die shoe—the leader pins—the leader pin bushings—bottom die tool sections—top die punch sections—the socket screws and dowel pins that hold them together—the stripper plate—the socket shoulder screws and stripper springs in the die—the socket set screws that hold the punches—the large socket screws that hold the die in the press—the bed and frame of the press—the crankshaft ram and connecting rod—the ram adjusting mechanisms—the clutch and brake assembly—the air cylinders that work the clutch and brake—the valve and regulator that control the air going to the air cylinders—the motor and drive—the relays that countrol the motor—the automatic oiling device—the electronic safety devices—the coil material straightener—all the assorted wires—leads—terminals—pipes—fittings—nuts—washers—screws and bolts which constantly keep coming loose—the conveyor to take the parts away—the conveyor to take the scrap away—their motors, drives and controls.

If the individual component reliability factors of each of the foregoing items are as high as 99.44 percent, and if there are 410 parts, the press will work satisfactorily on only 10 out of 100 tries. If as few as 100 total parts are used, and if each part is 99 percent reliable, then the chances of satisfactory performance will be 36 out of 100.

Yet many of the common parts used today are being sampled under quality-control procedures that allow for as many as four percent—two percent and in a few cases as little as one percent—falling outside the standards for dimension and performance in each 100 units. Actually, even if the individual reliability of each component in an assembly using 100 components is as high as 99.75 percent, the end performance of the assembly will only be 76 percent.

We've been lucky but, as things get more complicated and more expensive, our chances of failing are rapidly increasing. Little things are becoming much more important because everything must perform, or our whole operation stops. When the

The reliability of a machine is the multiplication product of the individual reliability factors of each of its components.

mechanical, electrical, pneumatic, hydraulic and electronic production combination grinds to a stop, which of the five experts do we call? Often a sixth expert is required to tell us which of the five experts can get our brain child into productive motion.

For information on reliable tools and material you have every right to rely on your industrial distributor and his organization of highly trained specialty men. It's their business to keep up on the latest developments in their several fields and they're doing an excellent job today.

Industrial distributors will not invest their money in products for their stocks unless they know the product has high reliability and yet they furnish their goods so they are still competitive in price. They handle items that will meet the highest requirements, as well as the average, so that your order can immediately be filled from their local inventories, thus insuring the reliability requirements of the customer. They are familiar with products conforming to manufacturer's standards, industry standards and American standards.

All of us as individuals are greatly indebted to the standardization work which has been done and is being done by all segments of our economy. I have intimately seen the benefits of these activities as president of the American Standards Association. Today at lower business levels there exists in all organizations the trained manpower of sufficient stature and experience to make greater strides in the development of American Standards than ever before. I encourage you and your companies to take an increasingly active part in standards work.

It is obviously an excellent investment and much more economical to build up a production unit out of standard building blocks wherever possible. In this way you take the maximum economic advantage of the blood, sweat, tears and combined past experience and reliability which have been written into any standard.

As your customers are going to require more economical reliability and quality from your output I suggest that you let the competitive facts of life be known to your suppliers. Insist that you secure from your outside suppliers of raw materials, parts and components the standards of size, interchangeability, finish, quality and reliability required.

You can no longer afford to accept the inferior reliability standards of the lowest-quality producer in an industry. Using inferior purchased parts and raw material is a reliable way of building unreliability into your product.

You will also find, as tool engineers, that it is increasingly valuable to get out to your suppliers' plants to see how they are operating. Are they living the good life of reliability? Nothing helps to put things in perspective so much as a look at the other fellow's shop and a talk with his people. For machines and machine tool requirements, put the machine tool salesman and machine tool distributor to work for you and don't be at all timid in requests for performance from the tool manufacturer.

Too many of our present model machines with new capabilities are being run like old model machines today. The possibilities of progress are often greatly held back by the old ideas we have grown up with even though in many cases we have the new machines already on the floor. Take a new look at what you already have. In other words, run your present late-model machines as they should be run. Bring in the machine-tool manufacturer representative now to review your present performance on his tools.

On the other hand, many present new machine tools are too often the same old gal in a new dress, because some conservative manufacturer is afraid to break with the past. This is readily understandable because today it is unbelievably expensive to bring out a complete new model that is free from bugs. So why not keep the old model alive with

By using standard items, maximum economic use is made of the combined past experience and reliability that have been written into any standard.

slight changes instead of designing a new model?

In our country everyone works for a consumer. And, Mr. Tool Engineer, you are the consumer of machine tools. Start with the latest standard ideas in tools, components and machine tools; aim high in your objectives. You are looking for a times increase and not a percentage increase in output. I repeat—aim high in your outlook on increased performance. More than 90 percent of any given problem can be solved in this manner. For the missing segments take advantage of the latest ideas, procedures and advanced techniques with a confidence that in this way new products and new standards are developed.

Enlightened research today must be aimed at the solution of tomorrow's problems before they become acute. Leading manufacturers in every field have many answers at hand for the unusual problem—they've been hard at work on the development of tomorrow's answers. Go to them and accelerate the development of the new pilot plant setup into everyday performance and performance for you—the man who dreamed up the new requirement—so that your target of increased production can be hit.

Today, for example, in the field of threaded fasteners for advanced applications, tensile strengths up to 300,000 psi are completely feasible and, at the same time, the fatigue strength of these products has gone up in proportion to the increase in tensile strength. It is almost four times higher than the strength of conventional threaded fasteners.

Make your plans and progress by using multiplication—you can get there faster than by using simple addition. Forward-looking manufacturers in all fields today have worked out possible solutions for the advanced requirements. Take advantage of their research and facilities. Above all, realize that as a tool engineer you don't run the production and, unless you can provide the operator on his job with the complete facilities to do his job, you haven't successfully fulfilled your mission.

Insist on a minimum-error tool. Put it on a modern machine tool with a consistent performance pattern. Provide indicating measuring devices at the machine work station so that the operator knows at all times where he is in respect to his tolerance limits. Assign a conscientious and properly trained operator to the job and insist that the products be run in the prescribed manner so that all of the output is made within the tolerance limits for size, finish and quality. No inspector can inspect quality and reliability into a product. Only the production operator can do the job—so help him.

To economically produce the reliability standards that are required for tomorrow's needs in this rapidly changing world of ours, more is needed than the tools, machines, gages and raw material. As automation is moving into all parts of the country we must realize that the human element is more important today than ever before if we are to have the reliability that all of us must have.

We must add the psychological factors of environment, interest and desire of the people working on each of the countless parts and on their assembly into completed units. There must be greater pride of accomplishment than we now find in our present-day assembly lines making aircraft, automobiles and washing machines.

Now is the time, during this economic breathing spell of 1958, to realize the unbelievable opportunities that lie ahead. Demands in the 1960's will require more and better products with greater reliability, and produced in the most economical manner, using minimum effort.

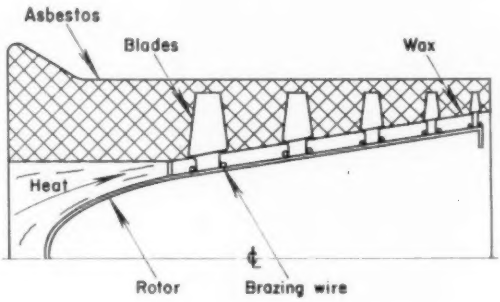
Re-examine every aspect of any production operation with the realization that, in the next ten years, to stay in business, a minimum increase of our mechanical output in relation to the manpower it requires must be between 50 and 100 percent. Ten men in 1970 must be able to do the work of 15 to 20 men today. And do a more complete and better job, turning out more reliable products with no increase in individual-worker effort. This is a challenge to all tool engineers. It is a challenge that must be met by puting new ideas to work today!

Today, machine tool manufacturers have the time and personnel to develop new models. Help them by making known future machine tool needs now.

Holding Parts for Brazing

Distortion of metal fixtures used to hold parts for brazing often causes misalignment of brazed parts. This problem can be eliminated by using the holding method illustrated. It was originally developed for holding blades to a jet engine compressor rotor.

With brazing wire in place, the blades are positioned on the rotor body. After strips of wax are placed between the blades, liquid wax is poured into the openings between the strips, blades and rotor bodies. When the wax is hardened, an asbestos composition paste is poured over the entire assembly. After the asbestos hardens, the unit is heated and the wax runs out, leaving the braze area open. The wax runs into molds for re-use.



During brazing, the asbestos shell holds the blades in place. Since the asbestos is not affected by brazing temperatures, the blades remain in correct position. After cooling, the shell is cut into strips and the asbestos is reclaimed. This method of holding parts for brazing has given good results in production and should be applicable to many similar products.

R. Dailey
Trenton-Delaware Valley Chapter

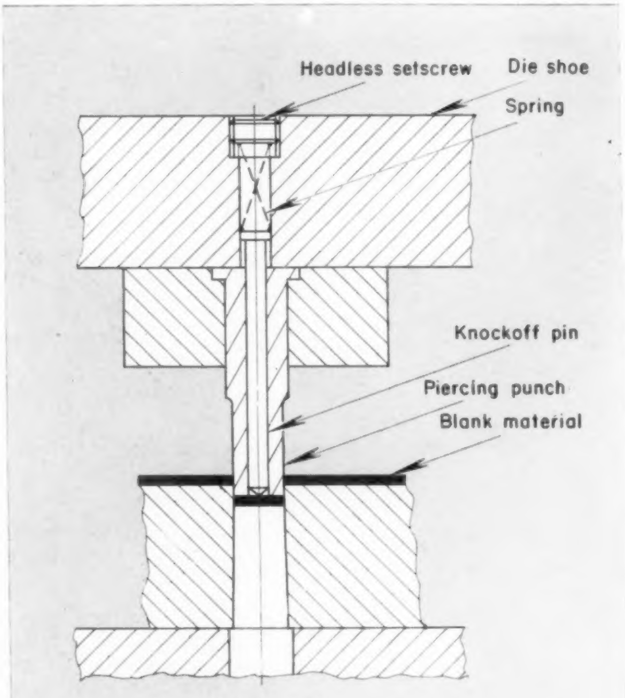
Knockoff Pin

When piercing holes in aluminum and other soft materials, the slug sometimes adheres to the punch on the upstroke of the press ram. This can cause damage to the die on the next downstroke.

The knockoff pin illustrated prevents such damage. A straight hole is drilled through the punch to receive the pin. The top die shoe is drilled slightly larger than the head diameter of the knockoff pin. This hole is tapped to receive a standard headless setscrew, which retains the spring.

In operation, as the punch contacts the blank material the spring is compressed. When the punch passes through the stock, spring pressure forces the knockoff pin downward, stripping the slug from the punch.

Roger Isetts
Kenosha, Wisconsin

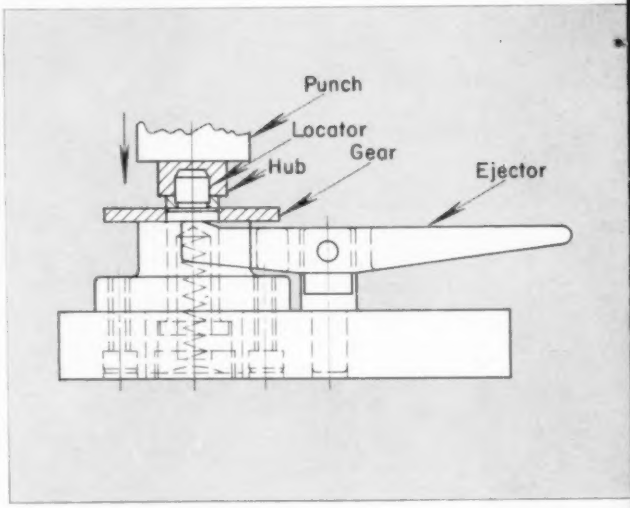


Pressing Fixture

When pressing a hub into a gear or similar part in an arbor press, there is always a possibility that the hub will be pressed in crooked unless a fixture of some kind is used to hold the components in alignment. The fixture illustrated is provided with a locator that eliminates alignment problems. Both diameters of the locator are ground to a slip fit on the inside diameters of the hub and gear shown.

In use, the hub and gear are slipped over the locator. As the punch presses the hub into the gear, the locator, which is spring mounted, is forced downward. On the upstroke of the punch, the locator returns to the "up" position. A manually operated ejector facilitates removal of the assembly from the locator.

C. Andrews
Dayton, Ohio

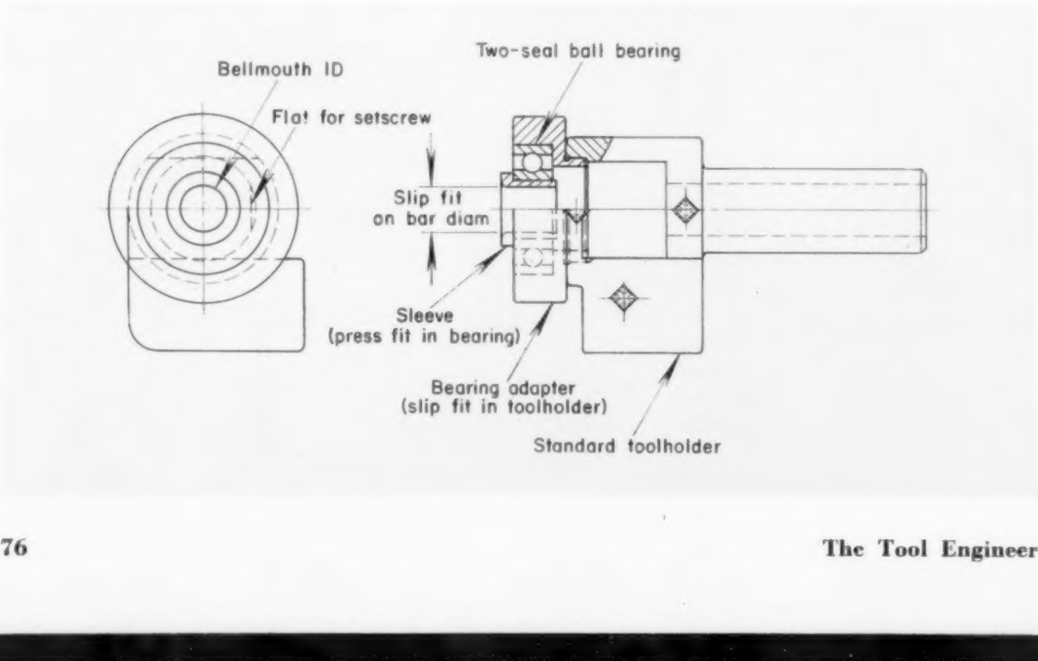


Screw Machine Bearing Support

In screw machine work, it is sometimes necessary to turn a long diameter adjacent to one or more short diameters in the same operation. Difficulty may be encountered in maintaining close concentricity between the long and short diameters. Normally, the short diameter is formed close to the spindle nose. Any centers or inside diameters are also machined at this time. Next, the bar stock is fed out to a second turret stop and the long diameter is turned, followed by back-chamfering and cutting-off operations. Concentricity and runout problems arise because all diameters are not completed at the same chucking.

The bearing support illustrated has proven to be valuable for such operations. The short diameter is machined close to the spindle nose. For machining the long diameter, the stock is guided through the bearing support. The stock is held concentric as the turning tool, mounted behind the support, machines the long diameter. Thus concentricity of the several diameters can be maintained within a few thousandths.

W. R. Eldridge
Greenwood, Rhode Island



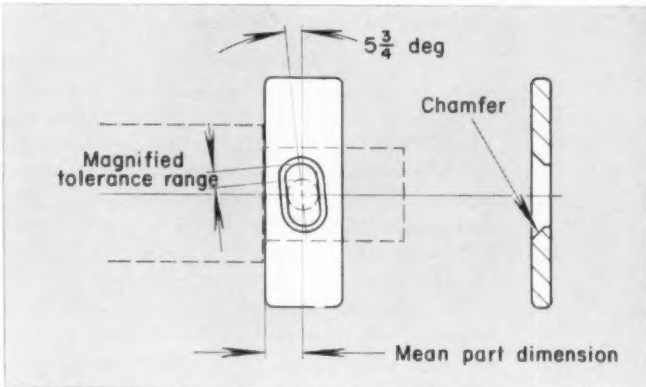
Gadgets

Target Type Gage

Gaging the location of a cross hole with respect to a shoulder or other part usually requires a rather expensive gage. If fractional tolerances are involved, the target type gage shown is an economical substitute for a special gage.

In use, the gage is moved until the hole being checked is exactly centered in the slot width. If the hole is within the slot, lengthwise, its position is within tolerance. The 5¾-deg. angle of the slot gives a magnification of ten times. Length of the slot should be appropriate to the tolerance required.

Don R. Ring
Milwaukee, Wis.



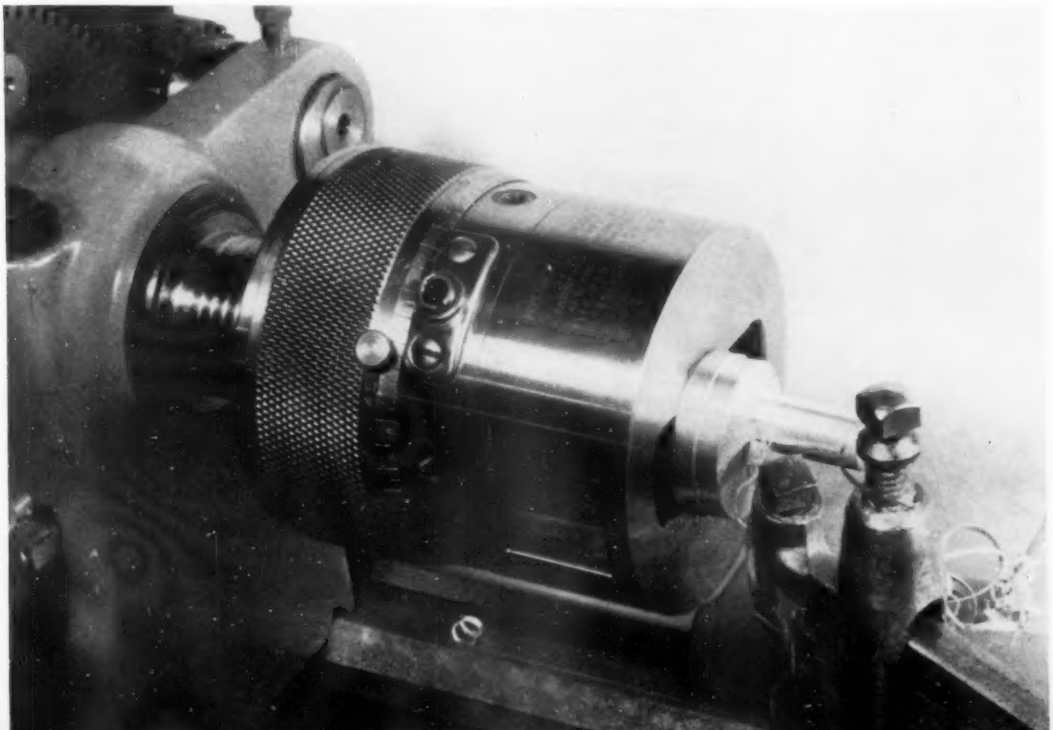
Machining Cranks

Production of small eccentrics and cranks, either in small production quantities or as single units, can be a problem in a small shop where special equipment is not available. A simple method for setting up a lathe for this type of offset turning is illustrated.

A standard offset adjustable boring head of the type commonly used in milling machines is mounted directly in the socket of the head spindle on a small bench lathe. The journal end of the eccentric, which has previously been turned on centers to proper diameter, is chucked in the "V" jaws which are normally used to grip the boring bars in this type of tool. The micrometer dial on the boring head is then adjusted for the desired offset of the crank stem and the crank is machined to the desired diameter.

The journal surface gripped in the jaws of the boring head should be protected with a soft metal sleeve to prevent any damage when tightly gripped. Boring heads of this type are usually equipped with shanks of various sizes which may be interchanged as needed. The one illustrated has a No. 3 M.T. shank, which is the correct size for the bench lathe spindle.

H. J. Gerber
Member-at-Large



Cone Turning Device

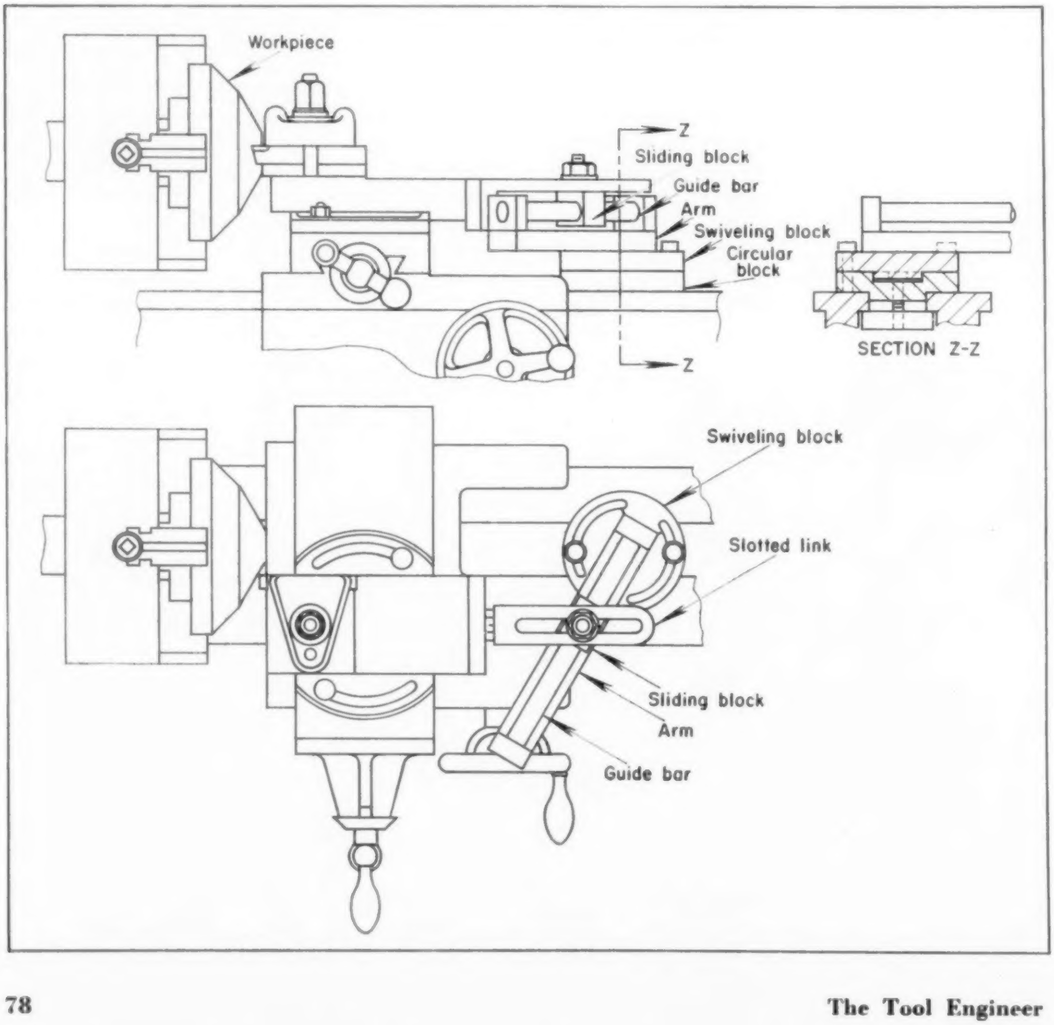
When turning bevel gear blanks, gyroscopic fly-wheels or similar conical workpieces on a center lathe, the standard type of taper turning attachment cannot be used. In the absence of a power feed for the lathe compound slide, small batches of conical parts are usually machined by hand traversing with the compound slide rest. This method is laborious and inefficient, particularly when the components are of high-tensile-strength forged steel.

The device illustrated enables conical surfaces to be machined with a mechanical feed obtained from the cross slide. As shown, a circular block is attached to the lathe bed slides to the right of the lathe carriage. A swiveling block can be adjusted and locked to the stationary block with bolts working in arcuate slots. If the swiveling block is calibrated in degrees, angles can be set directly.

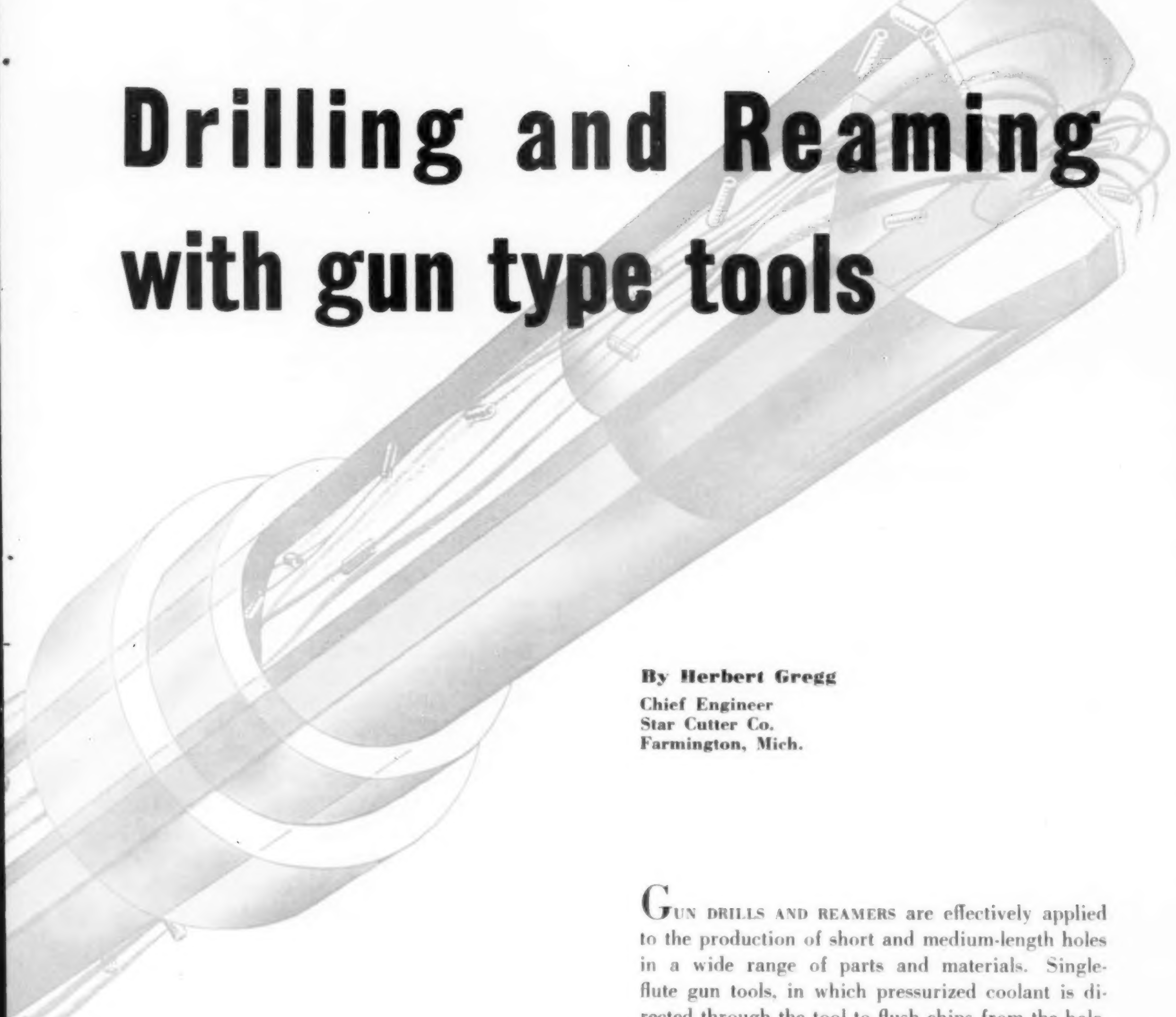
Blocks at each end of an arm secured to the upper surface of the swiveling block act as supports for a cylindrical guide bar of substantial cross section. A sliding block fits on the arm and carries a vertically projecting bolt which is attached to a slotted link on the lathe carriage.

When the saddle is locked to the bed and the cross slide mechanical feed is engaged, the block will slide on the guide bar, feeding the tool inward to produce a conical surface. To set the attachment for turning a different angle on the same workpiece, the nut on the sliding block is loosened and the swiveling block is readjusted and clamped. The link is then clamped to the sliding block so that work can proceed.

Clifford T. Bower
London, England



Drilling and Reaming with gun type tools



By Herbert Gregg
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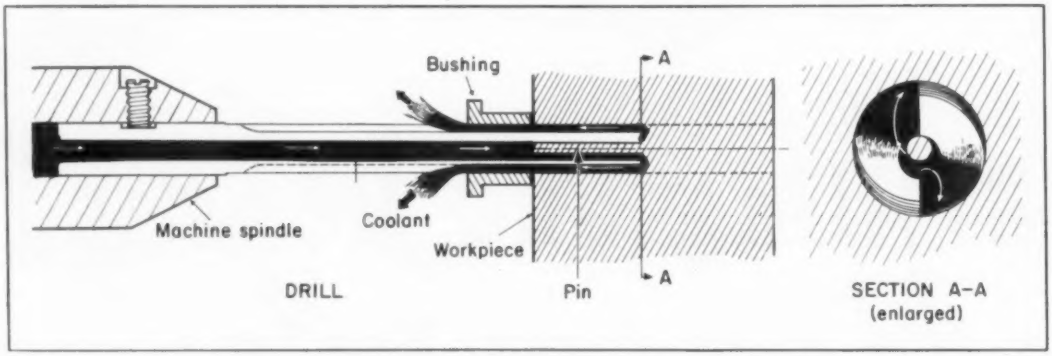
Gun type drills and reamers give excellent surface finishes and are capable of holding close size and concentricity tolerances. The author describes various tool designs and shows how they are applied to production.

Abstracted from Paper 102, "Production Drilling and Reaming of Precision Holes with Gun Type Tools," presented at the 26th ASTE Annual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

GUN DRILLS AND REAMERS are effectively applied to the production of short and medium-length holes in a wide range of parts and materials. Single-flute gun tools, in which pressurized coolant is directed through the tool to flush chips from the hole, have been applied for many years to the production of long holes. Today, carbide cutting inserts and heads for these tools, and the introduction of new designs of two-flute gun drills, have made it possible to hold closer tolerance and obtain better finishes than were possible in the past.

During the past few years, several types of gun drills have been developed, each of which has definite advantages for specific applications. These types include two-flute pin-cutting and two-flute center-cutting designs.

Two-Flute Pin-Cutting Drills: Two-flute, pin-cutting type of carbide gun drills have an off-center coolant through-hole in the molded carbide tip which generates a pin by a trepanning action. *Fig.*



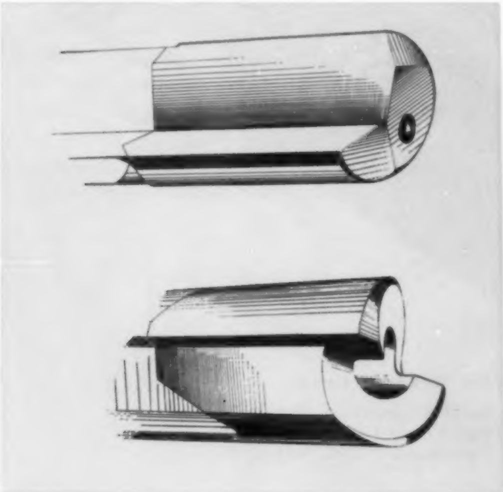


Fig. 1. (above) Coolant flow and pin generation of two-flute pin-cutting gun drill.

Fig. 2. (left) Single-flute gun drill (top) and two-flute pin-cutting gun drill (bottom).

1. The pin is flushed out of the work into a tube that directs it to the machine chip area. The carbide tip is brazed to a thick-walled tubular steel shank.

This tool has two cutting edges that provide a balanced cutting action, *Fig.* 2. As a result of the multiple cutting edges and this balanced action, extremely high feed rates and excellent size control are possible. Production applications since 1956 have indicated that the pin-cutting type of two-flute gun drill can be economically applied to produce precision through-holes from the solid in cast iron, aluminum, bronze and some stainless steels such as Type 440C, which forms chips that break up readily.

Two-Flute Center-Cut Types: If the hole in the carbide tip of a pin-cutting type gun drill is moved further off center, a tool results which will drill a hole without producing a pin. This tool has the balanced cutting action advantages of the pin-cutting type, and can be applied to the production of blind holes, holes that intersect cross holes, and applications where a pin is not desirable. High feeds and excellent hole size control are achieved with center-cut type tools. Such tools are especially suitable for drilling small-diameter holes, where the pin produced by the pin-cutting type is of extremely small diameter.

Single-Flute Gun Drills: Single-flute drills have one cutting edge, *Fig.* 2. Sizes under 7/8-inch diameter have a molded solid-carbide blank brazed to a thin-walled tubular steel shank. Sizes from 7/8 to 1½-inch diameter have insert carbide tips as well as two carbide wear strip inserts.

Single-flute gun drills have the advantage of forming a wedge-shaped chip during the hole cutting process. This chip tends to curl and break up easily, flushing out along the shank of the tool. Thus, chip clogging is avoided. Because of this chip generating action, single-flute gun drills are effectively applied in drilling holes in low-carbon steels where two-flute designs tend to clog due to the formation of stringy chips.

The cutting action of single-flute gun drills does not offer the balanced condition of the two-flute designs, so they must be fed at lower speeds. Thus, size control is not as close as with two-flute designs.

Gun Type Reamers: The success achieved by two-flute gun drills in producing smooth, accurate holes at high feed rates from the solid has led to a natural interest in applying the same design concepts to a reamer. The reaming tool has a molded solid carbide tip brazed to a thick-walled steel shank. The tip has two holes that direct coolant from the center hole in the shank to the cutting edges. Coolant pressure forces the chips ahead of the reamer.

Such reamers can be used to enlarge previously drilled or cored holes to finish size in a single operation. All types of ferrous and nonferrous materials can be reamed.

Fig. 3. Grinding the primary clearance for the short-lip outside cutting edge of a two-flute gun drill.

How to Set Up For Gun Drilling: Gun drilling tools can cut production costs by speeding drilling operations, eliminating reaming operations, and providing long-wear-life tools that produce a maximum number of pieces between sharpenings. In production applications, holes produced by both gun drills and gun reamers often meet blueprint specifications for surface finish, straightness and size accuracy without the need for subsequent honing operations.

Any rigid machine tool capable of producing the required speeds and feeds can be tooled for gun drilling. Either the drill or the work can be rotated. A precision hardened-and-ground steel or carbide drill bushing should be set close to the work to guide the tool as it engages the work. Gun drilling tools are relieved so that the bushing serves no purpose after the drill has entered the work.

The machine tool for gun drilling must be equipped with a pressurized coolant system that can direct coolant through the shank of the tool at pressures up to 1000 psi. The coolant system should also include a filter and magnetic separator to keep the coolant clean and free of chips.

The work fixture for gun drilling must be sturdy and provide features of hole alignment, concentricity and relationship required by the blueprint specifications. It is of interest to note, however, that some off-center conditions in cored holes can be tolerated by two-flute gun type reamers.

Gun drilling of conventional holes in high production is a relatively new concept and before an application is made, it is advisable to contact the gun drilling manufacturer and have the feasibility of the application proved on actual parts under simulated production conditions. Several drill manufacturers have production laboratory facilities to provide such investigations. It should not be necessary to investigate every gun drilling application, but the tool manufacturers now have sufficient background to make recommendations and suggest investigations when new materials or unusual applications are under consideration.

Sharpening Gun Type Tools: Any metalworking plant that has a standard cutter sharpener, a precision index head, an indicator mounted on a magnetic stand and an assortment of grinding

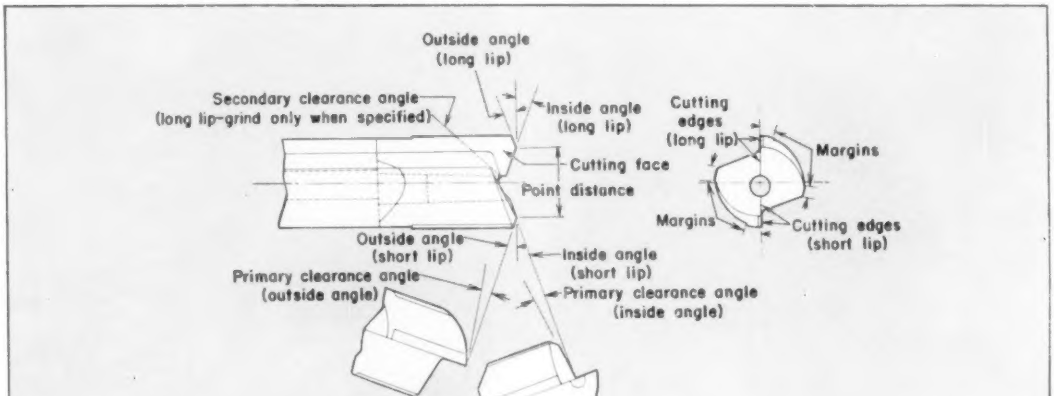


Fig. 4. Grinding specifications for two-flute pin-cutting gun drills.

wheels can sharpen its own gun drilling tools. A typical setup for sharpening a two-flute gun drill is shown in *Fig.* 3. Sharpening specifications are shown in *Fig.* 4.

Gun type reamers can also be sharpened with conventional equipment. Experience has shown that once a cutter grinding department has sharpened a few gun drills or reamers, these tools are processed through the department in a routine manner. However, when the cutter grinding department is careless and does not follow the manufacturer's blueprint specifications or sharpening instructions, gun type tools will not produce parts of consistent accuracy and long wear life.

It is extremely important that the cutter grinding department be brought into the gun drilling application program early. An understanding of sharpening requirements is essential to the success of any gun drilling program.

Wear Life of Gun Drilling Tools: If a gun drill has to be sharpened too often, its economy is of questionable value. There is now conclusive evidence to show that if gun drills are properly applied on properly equipped machines, if the tools are correctly designed and manufactured, and if they are sharpened at the proper time, they will provide more wear life than any comparable type of precision tool.

For a gun drill to operate satisfactorily, the coolant has to be clean, the machine must feed correctly and consistently, and the part must be properly held and processed prior to the gun drilling operation. These requirements are, of course, the same as those for any precision operation.

If a gun drill clogs with chips or is fed into the part at rapid traverse, it will break. If it is not sharpened correctly at the right time, it will produce out-of-size or rough holes.

But if usual care is accorded to the gun drilling operation—and it should be given the care accorded any other precision operation—the gun tools will produce hundreds or even thousands of pieces between sharpenings. There are actual gun reaming applications where one tool has reamed 50,000 parts before it required resharpening.

The grade of carbide for the tip is selected in accordance with the part material specifications. Gun drills are usually designed to provide about ½ inch of wear life in the carbide tip or molded blank.

Typical Applications: Today there are literally hundreds of successful production applications of gun drills on both deep and shallow holes, *Fig.* 5. The illustrations here have been chosen to demonstrate the versatility of gun drills as well as to show where various types of drills are being used.

Bronze Bushing: Gun drilling operations can be performed in conjunction with automatic loading equipment. An example is drilling solid bronze bushing blanks. The blanks are placed in a magazine, *Fig.* 6, and fed by gravity—one at a time—to drilling position. Finish-drilled bushings fall out at the base of the fixture and roll to the front of the machine in a trough. Hydraulic cylinders actuate the jaw chucking mechanism in the loader. Pins are ejected through the tube at the right of the fixture. The machine is an Ex-Cell-O Bor Dril. The operation is performed by a two-flute gun drill of the pin-cutting type. Hole size is 0.750 inch and

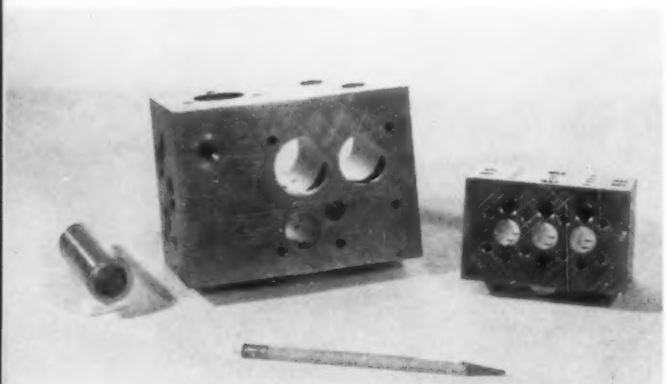


Fig. 5. Parts in which precision holes have been produced by gun drills. Left, a bronze bushing; center, a cast-iron block; and right, a steel block.

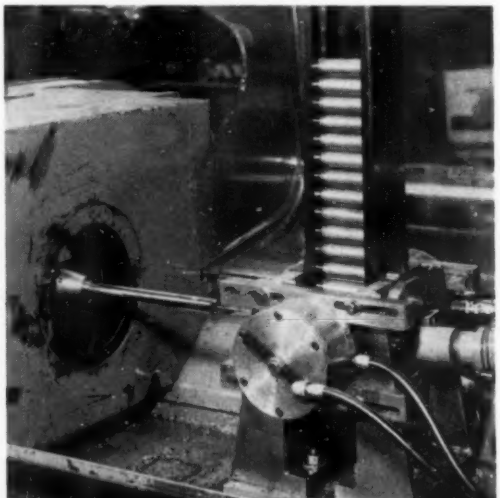


Fig. 6. (right) Magazine feed for producing a precision hole in a bronze bushing with a two-flute pin-cutting gun drill.

hole length is $3\frac{5}{8}$ inches. Tolerances for size are +0.0005 inch, −0.0000 inch. Concentricity with the OD must be within 0.005 inch. Drill speed is 4500 rpm and feed is 35 ipm. Coolant pressure is 350 psi. The surface finish obtained is 10-15 microinches, rms.

Steel Block: Gun drilling operations are not restricted to nonferrous metals. High speeds and feeds are used in drilling a steel block, *Fig.* 7. This block is clamped in a fixture on an Ex-Cell-O Bor Dril and three holes are drilled in the part, one at a time. The block is repositioned in the fixture for the drilling of each of the holes. These holes are drilled from the solid and each intersects two cross holes of smaller diameter. Parts are produced in quantity lots.

A single-flute gun drill is used. Each of the holes is 0.564 inch in diameter and $2\frac{3}{4}$ inches long. Size tolerances are ±0.001 inch and hole center lines must be parallel with the sides within 0.004 inch. Drill speed is 3800 rpm with a 6-ipm feed. Coolant pressure is 400 psi and 40-70 microinch finishes are obtained.

Cast-Iron Block: Drilling of a cast-iron block demonstrates the ability of a two-flute gun drill to produce holes from the solid in parts where a great number of cross holes are encountered. This part is produced in quantity on a setup similar to that for the steel block.

There are six holes, ranging in diameter from 1.375 inch to 0.500 inch, and in depth from $1\frac{1}{2}$ inch to $4\frac{1}{8}$ inches. Hole tolerances are ±0.0005 inch and holes are held parallel to the sides of the block within 0.002 inch. Surface finishes range from 50 to 60 microinches.

Aluminum Casting: The ability of a gun drill to produce excellent surface finishes in aluminum parts while holding close size and relationship tolerances is demonstrated by production of an aluminum casting on a Bor Dril, *Fig.* 8.

Two-flute center-cut gun drills are used in producing this part. The hole is 0.500 inch in diameter and $3\frac{3}{4}$ inches deep. Tolerances are +0.002 inch, −0.000 inch. The hole location must be held within 0.001 inch in relation to other holes in the part. Drilling speed is 3500 rpm and feed is 5 ipm. Coolant pressure is 600 psi. Surface finish of the drilled holes is 6-10 microinches.

Cast-Iron Cylinder Head: The possibilities of applying gun drills on transfer machines are illustrated in an application on an eight-cylinder engine cylinder head in which center-cut drills rough the valve guide bushing holes on an eight-spindle vertical head of a Foote-Burt in-line machine. The

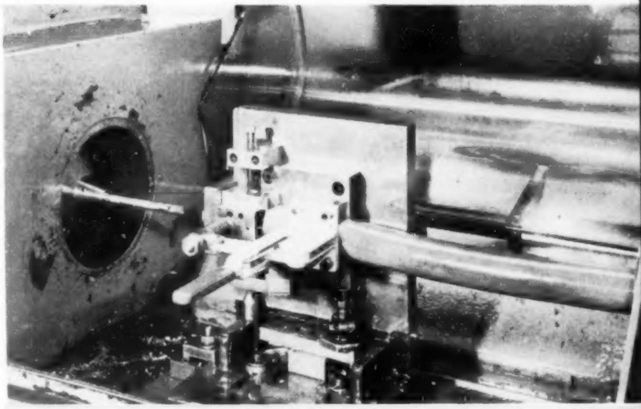


Fig. 7. Setup for drilling three holes in a steel block with a single-flute gun drill.

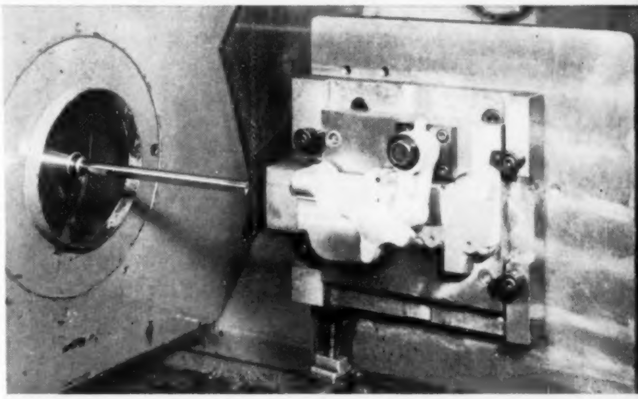


Fig. 8. Drilling setup for producing a hole in an aluminum casting with a two-flute center-cut gun drill. The hole is $3\frac{3}{4}$ inches deep.

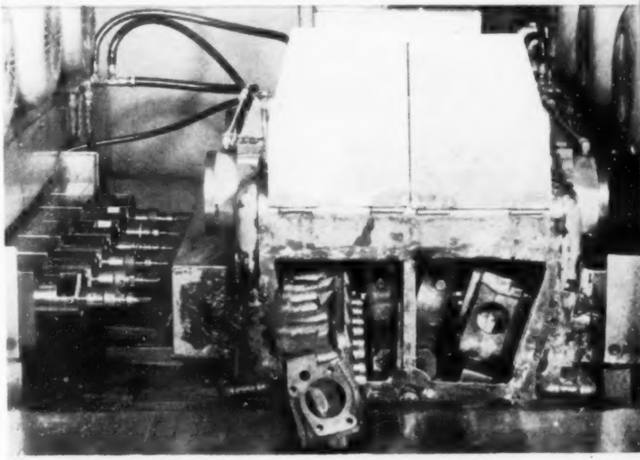


Fig. 9. Two-way boring machine on which valve guide bushing holes are gun drilled to finish size from the solid. Two-flute center cut gun drills are used.

holes are reamed to size with two-flute gun reamers on two stations following the gun drilling station. At each of these stations, a four-spindle head comes down and reams the valve seat; then telescoping spindles inside the valve seat reamer spindles extend to gun-ream the holes to size.

Each of the eight holes is drilled with a two-flute center-cut gun drill and reamed with a two-flute gun reamer. All holes are 0.3728 inch in diameter and $2\frac{7}{16}$ inches deep. Tolerances are +0.0007 inch, −0.0000 inch. Reamer speed is 2800 rpm and feed is 12 ipm. Coolant pressure is 400 psi. Surface finishes are in the 50-60 microinch range.

Six-Cylinder Head: In the same plant, twelve valve guide bushing holes in a six-cylinder head are produced in a single operation from the solid. Two-flute center-cut drills are used in six-spindle heads on a two-way Ex-Cell-O boring machine, *Fig.* 9. The same tolerances are maintained as with the drill and ream operation in the transfer machine. Thus, the possibility of using a gun drill to produce a reamer tolerance in drilling from the solid is indicated. Drill feed is 8 ipm and speed is 2600 rpm.

Power Steering Valve: Gun reaming eliminated a honing operation in the production of cast-iron power steering valve bodies. The part comes to a Bor Dril from a transfer machine with 0.0625 inch of stock left in the hole. The parts are gaged in three size ranges of 0.00013-inch difference within the tolerance range for selective fit of a piston at assembly. The reamed hole has a cross hole that does not affect the surface finish or size accuracy of the operation. The fixture has rubber plugs to stop coolant from spraying into the loading area, *Fig.* 10.

The tool is a two-flute gun type reamer. Hole size is 0.750 inch and depth is 3 inches. This is a blind hole. Tolerances are +0.0004 inch, −0.0000. Speed is 1650 rpm and feed is 6 ipm. Pressure of the coolant is 350 psi. Maximum allowable surface roughness is 70 microinches.

Bronze Bushing: Drilling holes in a naval bronze bushing was an extremely difficult application. As shown in *Fig.* 11, the long angular holes break out into half holes on the back side of the part. The naval bronze material is also difficult to machine. The part is mounted in a boring machine on a fixture with a bushing plate. After one hole is drilled, the part is turned and a gage plugged into the drilled hole to accurately locate the part for the drilling of the next hole. These bushings were made in quantity lots. Only a gun drill type tool would solve this difficult drilling operation in which accuracy was not a major consideration.

A two-flute gun drill of the pin-cutting type was used to drill the 10-inch-long holes, which were $\frac{5}{16}$ inch in diameter. Drill speed was 4000 rpm and feed was 2 ipm.

These applications demonstrate that gun drilling is a versatile process. The combination of relatively high drilling speeds, ability to hold close tolerances and excellent surface finishes should lead to many new and equally successful applications.

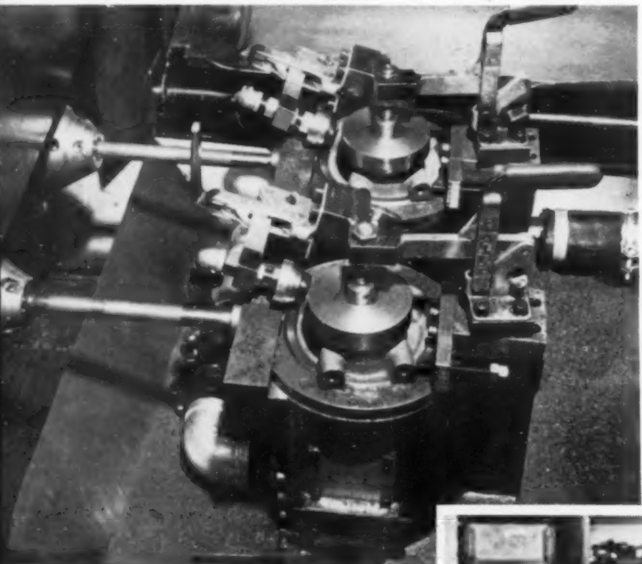


Fig. 10. Setup for drilling cast-iron power steering valve bodies. Rubber stoppers prevent coolant from spraying into the part loading area.

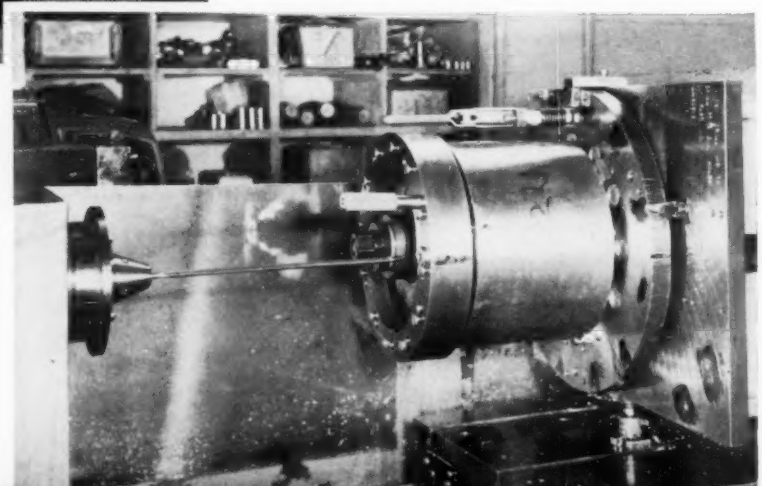
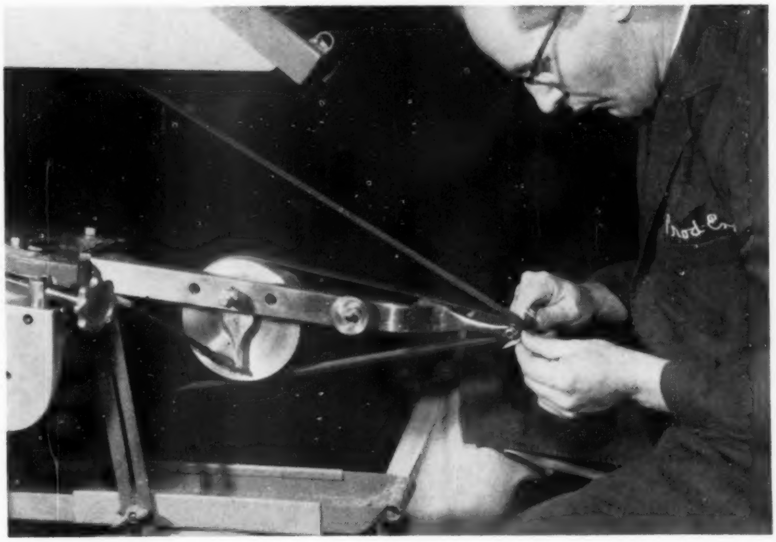


Fig. 11. (right) Setup for drilling 10-inch-long holes in a naval bronze bushing.

Fig. 1. Finishing a jet engine turbine blade on an abrasive belt machine. The machine is equipped with a special head to provide the proper radius at the working point.



what to look for in ABRASIVE BELT MACHINES

Tool engineers sometimes find an application for an abrasive belt grinder, but are in doubt as to what type of machine to buy. This article offers a check list of important structural and operating features, making it possible to select the right machine for every job.

By J. Karl McLaughlin

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MANY MANUFACTURERS are turning to the coated abrasive belt as a production tool for grinding and finishing. Although the abrasive belt is widely used on low-carbon steel, it is demonstrating its real advantages in work on alloys and special steels. Examples include widespread use on jet engine blades, *Fig.* 1; on heat-resistant alloys with a high percentage of nickel, chromium and cobalt; and on stainless steels.

As abrasive-belt techniques come into use, tool engineers are required to develop design specifications for abrasive belt tools. Extensive knowledge of design features is essential if top performance is to be realized from production machines.

Types of Operation: The simplest and most common design of coated abrasive belt machine, *Fig.* 2, operates the belt over a contact wheel and an idler pulley. Grinding or polishing may be done against the contact wheel, on the free belt in the unsupported area between the contact wheel and the idler, or on a belt supported by a platen, *Fig.* 3. Subclassifications of these types were discussed in "The Abrasive Belt and Its Use in Machine Tools," THE TOOL ENGINEER, May 1956.

The face of the contact wheel may be steel, aluminum, rubber, phenolic plastic or cloth, and may be flat or shaped. Contact wheels of soft rubber or

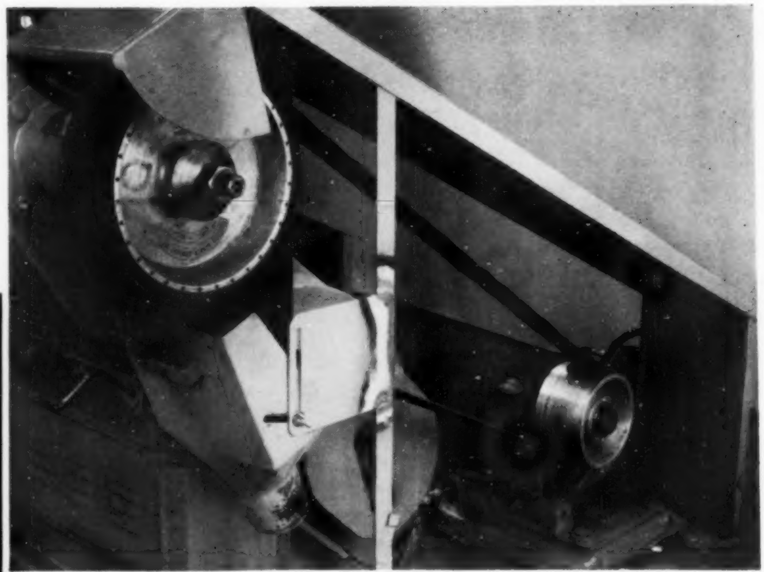


Fig. 2. Simplest type of abrasive belt machine operates the belt over a contact wheel and idler pulley. Here a standard polishing lathe provides power and mounting for contact wheel.

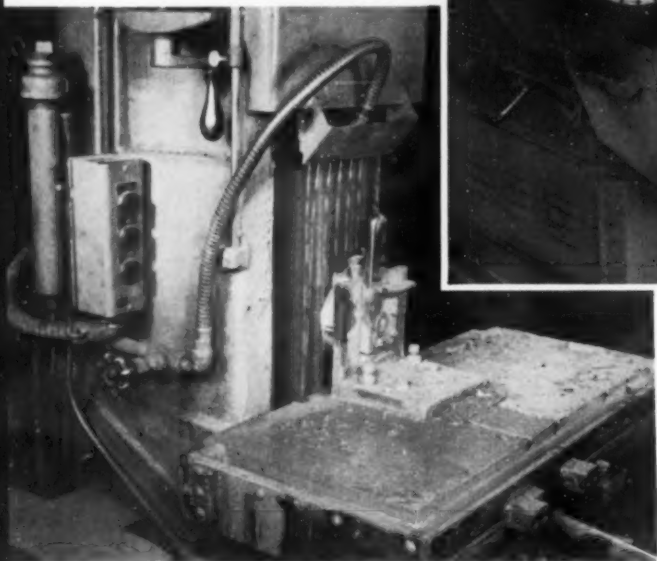


Fig. 3. Facing a die-cast aluminum pump housing to remove overflow and die punch-outs is performed with an 8 x 107-inch waterproof cloth belt with 80-grit silicon carbide abrasive, running over a steel platen at 5000 fpm. Hydraulic feed of the table advances the work to the belt; movement across the face of the belt is manual. Flash is removed later by offhand grinding.

pleated cloth have the ability to conform to changes in shape. Thus, they can be used for polishing contoured workpieces.

The free-belt method can be modified with formed rollers adjacent to the work area, which force the coated abrasive belt into a curved path to fit moderate contours. Rollers can be closely spaced to give the belt some firmness at the work area. In some cases the abrasive belt is supported with a back-up belt of fabric or rubber-impregnated fabric with its own tensioning and tracking devices.

Platens may be flat or formed. They can be made of metal, a ceramic, or faced with graphited canvas or other friction-reducing material. Platens are often faced with brass or steel shim stock which acts as a replaceable wearing surface.

Idler Assemblies: Contact wheels are either power driven or bearing-mounted on a dead shaft. Idler assemblies incorporate tensioning and tracking controls. If a contact wheel is power driven, the idler turns freely; if a contact wheel is bearing-mounted, then the idler must be powered. Many machines incorporate three, four or even five wheels.

Tracking is accomplished by pivoting the idler pulley in one of several planes, *Fig.* 4. Commonly, the pulley is crowned, *Fig.* 5, usually about 0.016 inch. If the crown is much greater, the center area of the coated abrasive belt may be stretched excessively until, in extreme cases, the belt folds over on itself. Also, a paper belt, less resistant to tension than cloth, may split if excessive tension is applied. An alternate method of tracking which has proved succesful is accomplished by lateral tipping of the axis, rather than by rotation or pivoting, with the face of the pulley crowned to a 24-inch radius.

Idler pulleys should have closed sides to keep out dirt which would destroy balance. Idlers are usually run on grease-sealed bearings. When large pulleys are used better control of belt tracking is attained and the larger contact area reduces slippage. Five inches is the minimum recommended pulley diameter. The idler pulley should be at least one inch wider than the belt, to give the belt some room for wandering as it gains speed when starting, and to prevent it from wearing the sheet-metal guards.

Sheet polishers, which use belts in widths ranging from approximately 14 to 86 inches, have flat idlers, *Fig.* 6. On these machines, tracking is accomplished by pivoting the idler in a horizontal plane.

One factor to be considered in the design of idler pulleys is the possibility of losing control of tracking while the belt is accelerating to its normal speed.

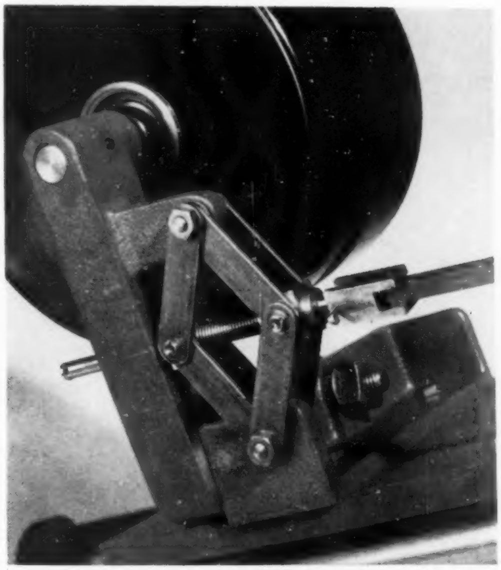


Fig. 4. Idler pulley with adjustable tracking device. Raising or lowering scissor jack tilts axis of pulley.

This condition is most likely to occur with belts one inch or less in width because their tractive grip is low. With such belts, it is advisable to specify lightweight pulleys which can build up to speed rapidly. In addition, large-diameter pulleys are desirable. Although they cost more than smaller pulleys, they permit reduced bearing speeds and get better belt traction, thus building up speed with less slippage.

Tension can be applied to belts by pneumatic or hydraulic means, by weights, springs, or positive screw adjustment of an idler base, *Fig.* 7. Probably the cheapest of these alternatives is a spring, but wide belts demand heavy tension which is best supplied by pneumatic or hydraulic force; these two methods offer the added advantage of instantaneous release of tension. Tensioning mechanisms should develop not less than 150 lb of force for each inch of belt width.

This much force may not always be required, but it will be necessary with heavyweight belts, particularly when they are oil-lubricated. It is necessary also on large centerless grinders and heavy stock-removal jobs. Within limits, heavy tension improves cutting action and increases belt life. High tension should not be exerted on soft rubber wheels, because it will deform them excessively.

Position of the idler is important in arranging pulley setups. On multiple-pulley machines, the crowned idler should immediately precede the driving pulley, and no matter how many pulleys are used, only one should be crowned. The three-pulley type, *Fig.* 8, is popular because it can be installed so as to save floor space, and provides both tensioning and tracking adjustments.

When tracking is screw adjusted, the handwheel should turn in the direction the belt is to go—clockwise for an adjustment to the right, as viewed from the operator's position. This avoids operator confusion. Remember, too, that the belt will run off the pulley on the low side, or the side exerting less tension. Idler pulleys should be balanced both statically and dynamically, particularly when they are to be run at high speeds. Equipment may develop serious imbalance if pulleys are not dynamically balanced.

When soft rubber wheels are used, maximum contact of belt with the contact wheel is desired. Engagement should be approximately 135 deg. For hard rubber wheels, a simple two-pulley arrangement will work satisfactorily, but with a soft wheel that must conform to a contour, use the pulley arrangement shown in *Fig.* 9. The angle at which the abrasive belt approaches and leaves the grinding point is critical, and should not exceed seven deg.

Speeds and Power: In general, high speeds result in best finishes, other factors being constant. The current trend is toward lower belt speeds, but testing has revealed no advantage in speeds less than 4000 fpm except with titanium, where high temperature at the grinding point results in rapid erosion of the abrasive grain. High speeds will produce a slightly finer finish, grit for grit, but this advantage may be offset by the action of centrifugal force

Fig. 5. Crowning idler pulley slightly facilitates tracking. Crown should not exceed 0.016 inch.

on a soft rubber contact wheel. At extreme speeds, such wheels become harder, losing the flexibility which dictated their selection in the first place.

When finishing mild steels, it is not usually desirable to cut more than 0.002 inch at a pass with the normal work feed of 14 fpm. Reducing the feed rate to as little as six ipm may make a cut of 0.060 inch per pass with a 50-grit belt completely practicable. Therefore, it is wise in designing a belt-using machine to incorporate step pulleys or a variable-speed feed mechanism.

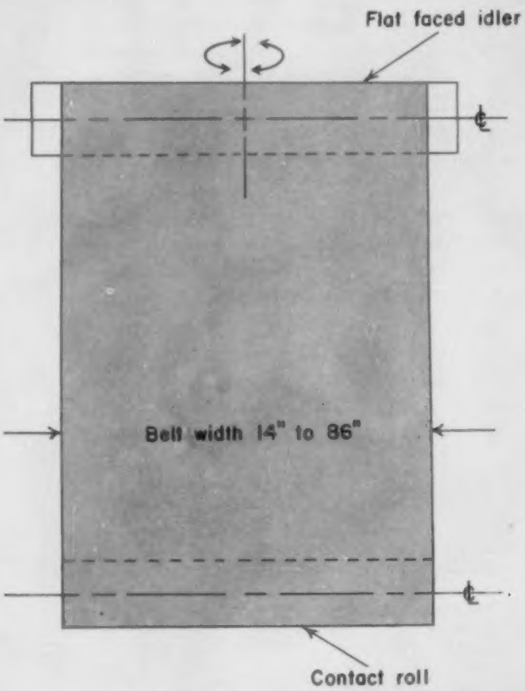


Fig. 6. Wide belts are usually run on flat idler pulleys. Tracking is accomplished by tilting or rotating pulley axis.

Power requirements depend on type of operation. Coarse grits and wide belts remove more stock and consequently require more horsepower. Recommended motor sizes are shown in the accompanying table.

Mechanical Features: The principal mechanical requirement is rigidity because shafts are supported at one end only. To prevent creeping, weldments should be stress-relieved. Good seals should be specified on all bearings as protection against abrasive grit, particles ground from the work and coolant. For ease of access, grease nipples in awkward locations should be extended.

Machines should be equipped with adequate guards for contact wheels and belts. It is important that these guards allow plenty of room for removing and replacing belts. If a machine is equipped with a conveyor, the operator should stand a bit to one side of the take-off point, in case a workpiece should be picked up and thrown as it leaves the grinding point.

If a conveyor is desired for moving work into the grinding area, any of three types may be specified. Sponge-rubber conveyors belts, into which the workpiece sinks deeply enough to be carried to the contact wheel, are used primarily with light nonferrous or nonmagnetic stainless-steel parts on finishing operations. Rubberized fabric belts with cleats prevent workpieces from slipping back at the working point. Abrasive belts allow the work to travel close to a permanent magnet and, since they are thin, allow working to closer tolerances. All types of conveyors require tensioning and tracking controls.

Work may be hand-held or it may be chucked in mechanical, magnetic, pneumatic, vacuum or hy-

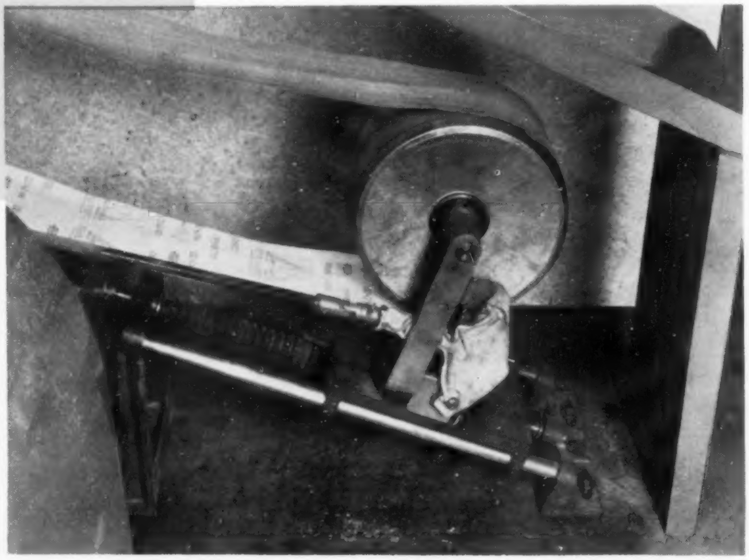


Fig. 7. Idler pulley with screw adjustment for tension control. Screw is covered with accordion boot for protection from abrasive dust.

draulic fixtures on semiautomatic indexing machines with loading and unloading stations. It can also be ground or polished on a fully automatic rotary machine. Often a latching mechanism may be used to hold the piece in a fixture. If the part has a suitable projection, it may engage a hole or slot. In planning for semiautomatic or automatic production line setups, it is well to remember that the maximum number of stations on a rotary machine is fixed; the straight-line or return straight-line setup can always be extended as the need arises.

Cooling: For applications requiring cooling, best rates of stock removal are accomplished with sulfurized and chlorinated grinding oils. For fine finishes with grits of 220 or more, oils of light viscosity must be used. Generally, water with rust-resistant additive does not give as fine a finish as oil. Also, the use of oil gives greater production per belt than water.

Use of water, with rust inhibitor added, improves the finish, gives the best cooling action and is safest of the coolants, though it requires the use of waterproof belts that cost more than the standard belt.

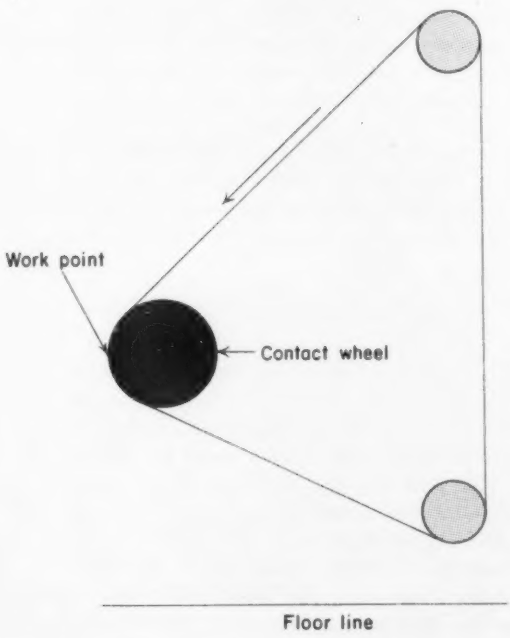
The coolant supply lines should not be skimpy. On 50-inch machines, for example, they will have to deliver a volume as high as 100 gpm. Nozzles should be screw-on types, quickly removable for cleaning or replacement.

One coolant nozzle should be directed squarely at the grinding area between belt and workpiece and a second should be positioned at some point between the pulleys to direct the fluid at the abrasive side of the belt, in order to flush it clean of abrasive particles and chips. Coolant tanks should be fitted with access doors to allow easy inspection and cleaning.

Filtering Coolants: Filtering can be done with a settling tank, with centrifugal separators, or a paper or cloth filter. If very fine grits are being used on nonferrous parts, the fine grinding swarf must be filtered out by some means more effective than settling. Otherwise, some swarf may be carried back to the grinding point, causing wild grit lines or other surface defects.

Many companies have installed cooling units on filtering systems because some oils deteriorate if allowed to become hotter than 140 F. If several machines are to be set up in a line, installation of a central filtering system will prove economical.

Dust Collection: Abrasive belt machines should have enclosed hoods for dust and vapor removal by vacuum. One take-off point, *Fig.* 10, should be close to the grinding point, another at the far end of the hood. In severe applications when fine grits are used, the coolant tends to become misty—a condition most likely to occur with oil. Here, the ideal is an



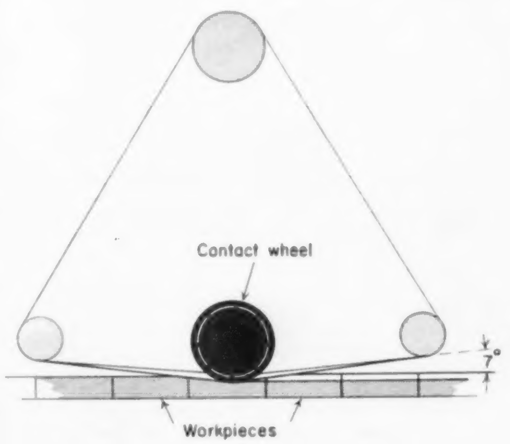


Fig. 9. (above) For work with soft wheels where belt must conform to a contour, angle of belt with work should not exceed seven deg.

Fig. 8. (left) Three-pulley arrangement saves space while providing adequate belt length.

Horsepower Requirements for Abrasive Belt Machines

Operation	Belt Width (inches) 6 or less	6-12	12-75
	Horsepower		
Stock Removal (coarse grits)	1.5	2	2.3
Intermediate Duty	1	1.5	2
Polishing	1	1	1.5

electrostatic type of separation system; however, many plants use mechanical baffling systems successfully.

Dust collectors must be adequately powered; often, they require more powerful motors than the grinder itself. Dry grinding with greases tends to build up a deposit in collector pipes. To make clean-out easy, access doors should be built into ducting. On wet systems, collector ducts should be pitched so as to drain back toward the machine, and should be designed with a collection point for condensed vapor.

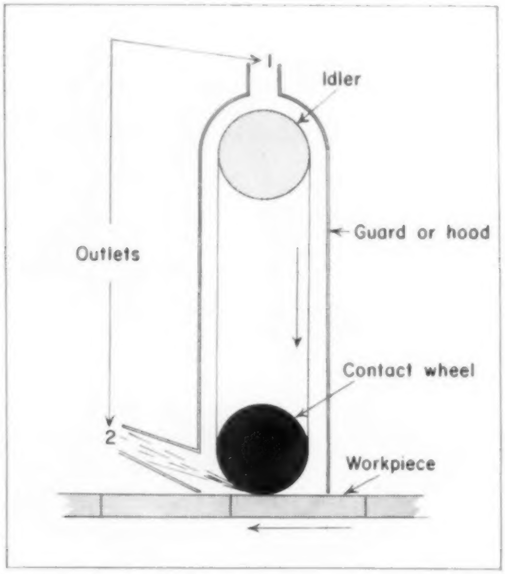


Fig. 10. Enclosed hoods for dust collection should have two outlets. Fans should be adequately sized for satisfactory dust removal.

Electrical Considerations: Reversible motors add versatility to abrasive belt machines, permitting belts to be run in either direction. To get the best finish, belts should be run in the direction of work feed; for maximum cut, against the direction of work feed. Rapid belt oscillation produces a series of short grit lines instead of long, continuous lines, giving the work a better appearance. For trouble-free operation, motors should be totally enclosed, with an indicator light to show when the power is on. If a light is installed in a belt compartment, an explosion-proof fixture should be used, particularly if oil is the coolant.

A master switch, allowing the operator to cut off all power, should be installed where he can reach it instantly. Electrical interlocks should be wired in such a way that the main motor cannot operate until tension has been applied to the belt. Similarly, coolant pumps should be operating before the main motor starts.

The use of water as a coolant requires watertight seals on motors and electrical fittings, and thorough electrical grounding of the machine. Shields should be installed around the grinding point, adequate to protect the operator and his station from splashing.

On large machines, particularly those which are totally enclosed and on which work is fixture-held, it is common practice to install an ammeter in the power line to the belt-driving motor. Observation of this ammeter allows belt pressures to be set and held accurately. This is an important consideration in noisy locations where the operator is unable to check belt performance by ear.

Major trends in metalworking which have significance to the purchaser or builder of belt-using machines include polishing sheet metal before forming; installation of rotary and straight-line automatics for polishing die castings and formed-metal parts; and, certainly, the growing dependence on these semiautomatic and automatic machine tools to reduce labor cost, improve quality and increase hourly output.

A completely new industrial tool has recently made its appearance with the development of "wearable" coated abrasive wheels, which hold a contour throughout their lives, and require no idler or tracking equipment. Such wheels will find application in a myriad of polishing and finishing operations because of their simplified design, adaptability and long life with minimum down time. On many lines wearable abrasive wheels will be found completing the automatic sequence initiated by belt-using machines.

***"Any successful concern, in my book, is the one that runs the best errands for its customers, and the successful researcher is the one that runs the best errands for ideas. Once you pull an idea out of oblivion, you never put it back, and therefore we have to deal with all of these new things that come, and provide a proper integration of those things into our everyday life."*—Charles F. Kettering, Director & Research Consultant, General Motors Corp.**

tooling for CERAMICS

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IN THE QUEST FOR HIGHER PRODUCTION, attention is naturally focused on higher cutting speeds. The advent of ceramic tools gives some indication of what may be expected for practical cutting speeds in the not-too-distant future. However, a number of changes must be made before cutting speeds in excess of 2000 fpm can be used successfully.

Normally, the principal factor limiting the cutting speeds is the tool material. As the cutting speed increases, the temperature at the cutting edge increases and, as a result, tool life decreases. Note how the hardness of each type of tool material, *Fig.* 1, drops rapidly as the temperature passes the critical region for that particular material. High-speed steel is satisfactory if the tool temperature does not exceed 600 to 700 F. Carbides fail at temperatures above 1000 to 1200 F.

The practical cutting speed range appears to be extended considerably with the development of the ceramic tool, since hardness does not appreciatively change under normal temperature changes. This tool consists of aluminum oxide and a binder and, hence, has the ability to withstand much higher temperatures than any of the other tool materials now being used. As with any new type tool, a technique for using these tools must be developed before they can be applied successfully.

As the cutting speed increases, the rate of metal removal increases, and the horsepower requirements increase in almost direct proportion. Since most machine tools being used at the present time have neither the speed range nor the power necessary for use with ceramic tools, the full utilization of ceramic tools at the higher cutting speeds must, of necessity, wait until machine tools of higher power and speeds are available.

Another requirement of the higher speed machine tools will be self-balancing devices to take care of the unbalance in odd-shaped workpieces rotating at high speeds. Any unbalance results in vibrations which are disastrous to tool life. Also, mechanical systems will be required to remove the chips. The removal of chips has always been a tedious problem, even at cutting speeds being currently used.

At the higher cutting speeds new types of cutting fluids will be needed. The emphasis should be on a cooling rather than a lubricating type of cutting fluid. These new cutting fluids should have more heat-absorbing capacity than present ones.

One such cutting fluid might be a fluid containing solid particles which absorb heat as they melt. The particles would resolidify in the reservoir of the machine tool.

It should be noted that at the higher cutting speeds, the machining time becomes less important in the production cycle. The factor which increases in importance is the time required in loading and unloading and tool changing. Automation has, of course, helped in the loading and unloading cycle, and the "throw-away" tool bit has been helpful in reducing tool replacement time, thus increasing productivity.

*Senior member ASTE Cincinnati chapter.

Abstracted from Paper 83, "Changes Necessitated by Higher Cutting Speeds," to be presented at the 26th Annual Meeting. Copies of the complete paper will be available for purchase from Society Headquarters.

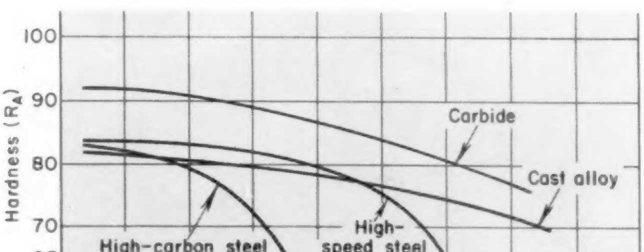


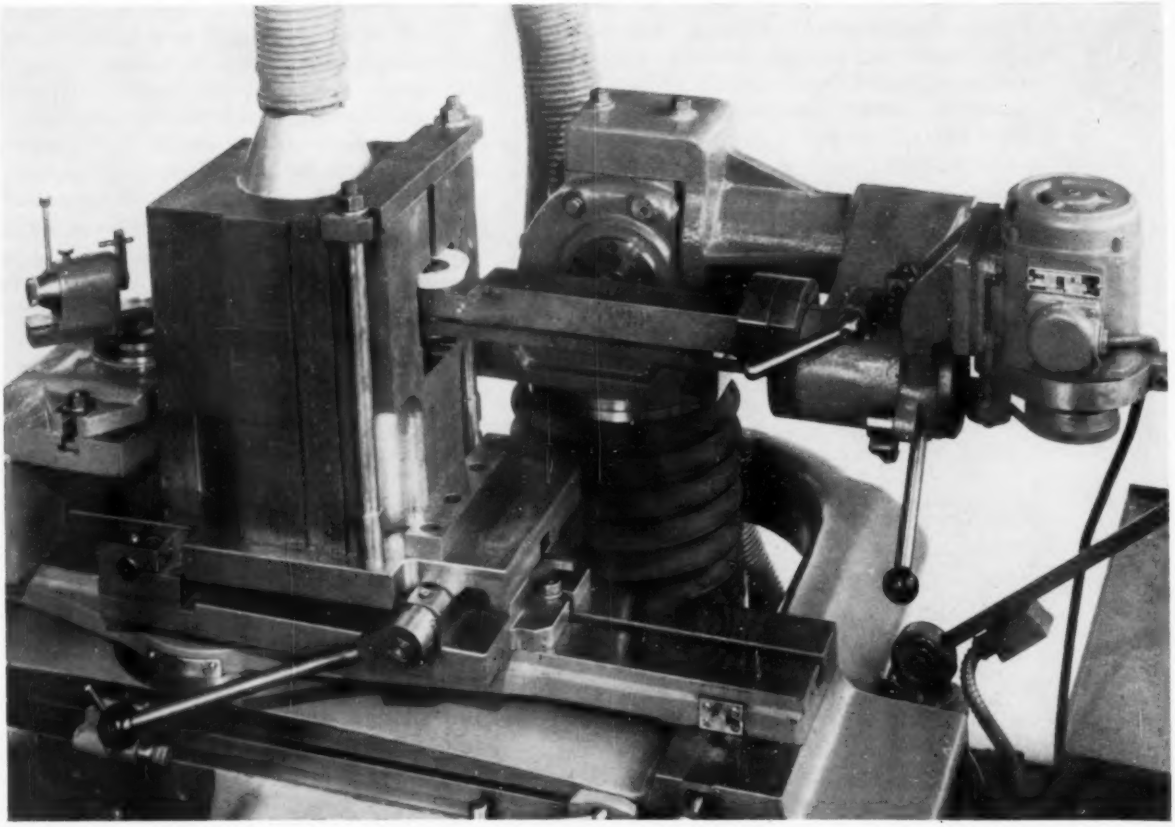
Fig. 1. Effect of elevated temperatures on the hardness of tool materials.

designed for

PRODUCTION

Grinding Wedge-Shaped Holes

To grind holes for the breech-block in breech-ring of 40mm AA guns, Artillerie-Inrichtingen, Netherlands, designed special tooling for use on a universal tool and cutter grinder. Six flat surfaces, one of which is inclined 86 min., and six rounded corners are ground. Length of the wedge-shaped hole is 9.5 inches, having tolerances within 0.002 inch. Surface quality is required to be 8 micro-inches. Drive is through flat fabric belt. Stops for 90 deg rotation of grinder are set with bolt and locknut.

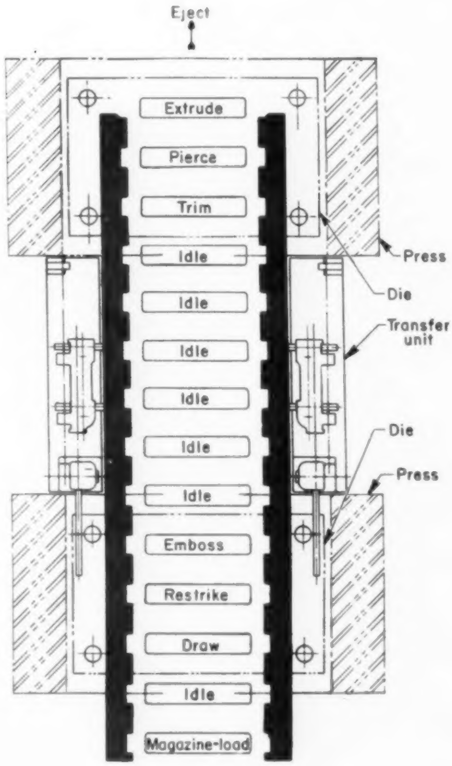


Transfer Unit Uses Press Power

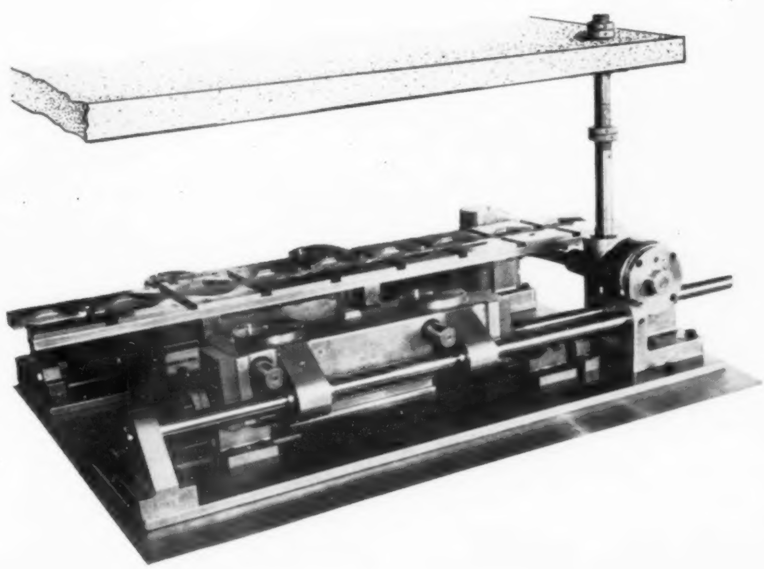
Any standard press can be converted to a transfer press by using a transfer unit that needs no extra electrical, hydraulic or pneumatic aid as a power source. The unit, designed by Livernois Engineering Co., uses the power of the press ram to actuate the mechanism.

As the ram travels downward, a rack connected to it operates a gear unit to translate the motion into two other planes. This action operates the feed fingers which retract from the workpiece as well as returning the slide to the preceding station. As the ram returns after completing the operation on the workpiece, the fingers pickup the next workpiece and the slide moves the part to the next station.

The unit easily converts to other sized workpieces by substituting interchangeable bars with new feed fingers for the ones being used. Adjustment of travel for the fingers and feed for the slide can be made right in the press.



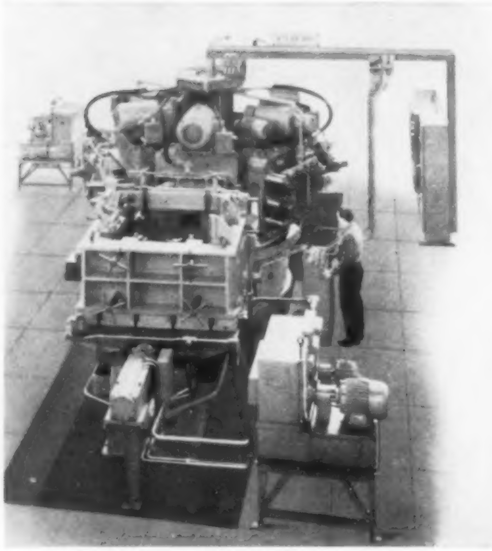
(right) APPLICATION of the unit for two-press operation to automatically process a workpiece from magazine feed to finished part ejection.



TRANSFER unit with feed rack operated by press ram to control feed for fingers and transfer. The unit is adjustable in width and length by changing the bars.

DESIGNED FOR PRODUCTION

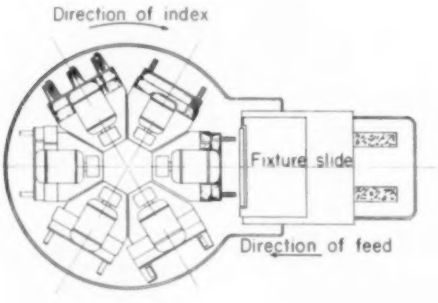
Automatic Machining of Large Workpieces

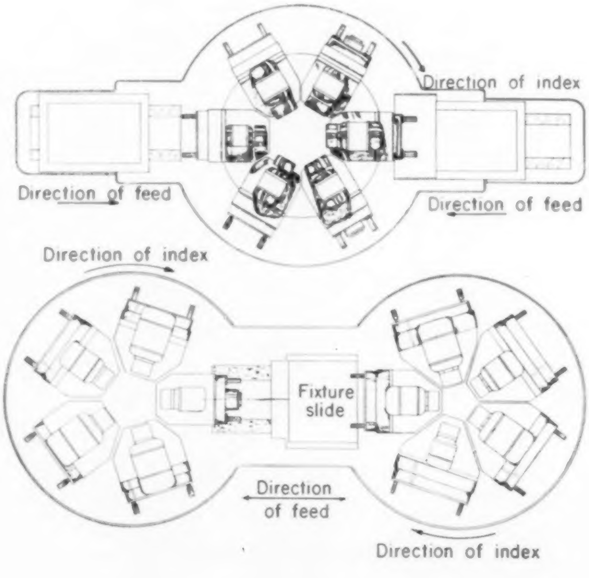


INDEXING MACHINE in loading position. Clapper switch is located on the center column preventing operation of machine heads except when located in front of fixture. Spring loaded guide plates shown on head at left position in the fixture on guide pin and hold drill bushings in relation to workpiece during machining.

Given the conditions of machining large castings and weldments for earth-moving equipment and sufficient production to warrant use of special-purpose machines, what is the best way to process these parts? To solve this problem, W. F. & John Barnes designed machines using the spindle-head stations mounted on a rotary table and the workpiece on a fixture slide. In this way, the massive parts are machined without needing to move the part from station to station as in a transfer machine. Also, rather than have the tools feed into the work, the workpiece is hydraulically fed into the cutting tools when the fixture slide is operated.

The tool heads are mounted on either four, five or six-station rotary tables, depending upon the number of process stages. Indexing is accomplished hydraulically with the table slightly raised on an oil film during indexing. As the pressure to maintain the film is reduced, the table settles resulting in a smooth braking action. Machine interlocks prevent feeding of the workpiece into the tool heads during indexing of the tools. Clapper type switches eliminate the need for slip rings, and only allow cutter head to operate when the unit is in cutting position.





SOME possible variations in the application of the rotary tables and fixture slides to extend building block principles of the equipment to meet conditions of increased production rates or changes in process steps.

PRECISION GRINDER ends rework problems

By Edgar M. Hakanson*
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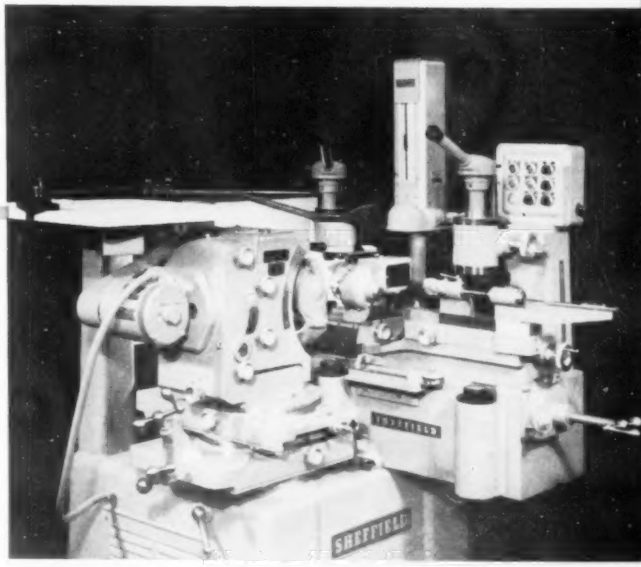

Fig. 1. Optical methods are used for match grinding of servo valve spools. Spool is viewed in left-hand microscope; microscope at right gives view of matching sleeve. Air gauge measures stock removal during correcting operations.

RELIABILITY OF COMPLEX MISSILES is dependent, to a large degree, on the reliability of their hydraulic systems. The most critical components in these systems are the valves that control the flow of fluid. With missile designs calling for higher operating pressures, it has become essential to hold manufacturing tolerances within closer limits.

This is particularly true of valve sleeves and spools. The relationship of the edges of the spool lands to the inside edges of the sleeve ports is all-important in guiding hydraulic flow through the ports. Too much overlap (land extends too far past port edge) causes lag in response, while negative overlap (land width is less than specified) allows fluid leakage that may result in slow or incomplete control action.

There are several approaches to producing matching parts. In one approach, spools and sleeves are machined to extremely close tolerances so that all spools and sleeves are completely interchangeable. Another approach is to forego complete interchangeability and produce spools and sleeves as matched pairs. After studying the relative economics of both approaches, Sheffield engineers decided that production of matched pairs offered maximum operating economies. Accordingly, they designed a special machine for match grinding, *Fig.* 1.

The machine has a grinding station for the spool, *Fig.* 2, and a viewing station for the sleeve. Each station has a separate adjustable worktable, a set of centers and a microscope.

In setting up for grinding, the operator places the spool between centers and adjusts the table until the image of the first shoulder appears in the microscope. A fifty-to-one ratio pantograph is interlocked with the micrometer adjustment of the microscope. Adjusting the micrometer one-thousandth of an inch moves the cross hairs of the microscope twenty millionths of an inch. By use of the micrometer, the operator can adjust the cross hairs to provide the necessary amount of stock removal, plus the amount of overlap required. In most cases, the overlap requirements are 0.0002 inch.

Once the spool is in proper grinding position, the sleeve is positioned in the viewing station, *Fig.* 3, so that the porting edge corresponding to the first shoulder of the spool comes into view. The optics

***Senior member ASTE Dayton chapter.**

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Fig. 2. Typical hydraulic servo valve. Overlap between lands and port holes prevents fluid leakage.

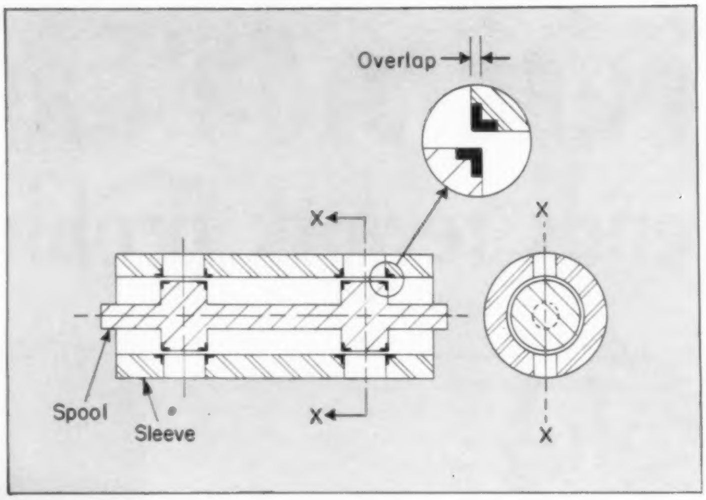
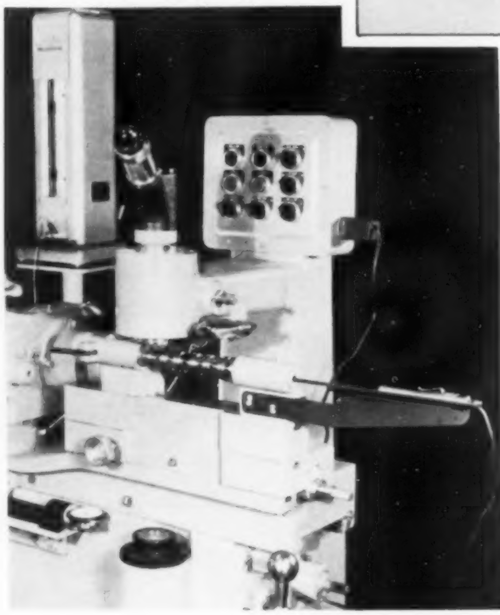


Fig. 3. (below) Sleeve in position in match grinder. Grain-of-wheat lamp illuminates inner porting edges.



in this station are so arranged that the lower or inside porting edge is in focus. This is the edge that does the actual porting of the hydraulic fluid. A collimated light source provides a shadow image and a small grain-of-wheat light illuminates the inside of the sleeve, making it possible to inspect the porting edges for squareness with the bore and coaxial alignment.

After the porting edge and the cross hairs in the microscope are aligned, the table holding the sleeve is locked to the grinding table, establishing the sleeve and spool in fixed relative position. The operator then manually grinds the porting shoulder, usually removing 0.004 to 0.006 inch of excess stock. The grinding wheel and the stock to be removed are visible to the operator through the microscope at the grinding station and he stops grinding when the edge of the shadow image of the work reaches the cross hair. The relationship of the ground shoulder to the corresponding porting edge is accurate to within ± 0.00015 inch.

Next, the remaining porting shoulders are ground, using the same procedure as for the first operation. This is accomplished by moving the main table until the appropriate porting edge is positioned under the cross hairs of the microscope. Since the valve and sleeve are not removed from the machine until the grinding operations are completed, maximum accuracy is obtained.

Grinding is followed by flow testing. If further correction is necessary, the amount of stock that must be removed from each porting shoulder on the spool is recorded. The spool is then returned to the grinder and placed in the grinding station. In most cases, the correction of the spool requires removing less than 0.0003 to 0.0004 inch of material.

A sensitive air indicator is brought into contact with the work at a specified distance below the porting edge. The indicator is connected to a column type air gage. During grinding, the amount of stock removed is indicated directly on the gage. Grinding accuracies are held to plus or minus ten millionths of an inch.

Previous methods of manufacturing servo valves have required flow testing and correcting the spool as many as twelve times. The new machine makes it possible to match grind the majority of spool designs to the required accuracy without additional correction. For extremely critical valves, one correction usually suffices, although sometimes a second correction is required to bring the valve into perfect balance. By eliminating or reducing the number of correction operations required, the new method has significantly reduced manufacturing time and scrap losses.

AUTOMATIC MANUFACTURING

with an integrated line

Low-cost automation is possible with conventional machine tools and standard materials-handling equipment. Basic principles of such combinations are discussed in this article along with applications.

By Don A. Cargill
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MANUFACTURING is more than working metal. Material handling, inspection, information direction, inventory control, and scheduling all form a part of the manufacturing process. Any combination of machinery and people that manufactures a product can be considered a manufacturing system. The system can consist of a combination of conventional general-purpose machines, a combination of highly specialized special-purpose machines or a combination of both.

The Integrated Line: Industry has a common goal—the automatic factory. One path toward that goal is the employment of the integrated line. The integrated line is a systems engineering approach to the automatic factory that is evolutionary rather than revolutionary. An integrated line is a manufacturing system that is a combination of conventional machine tools with standard materials-handling equipment. The integrated line may be as automatic as desired. The degree of automation is roughly proportional to the investment in automatic materials-handling equipment.

The evolutionary integrated line utilizes the current skills of employees and is easily visualized by production and design personnel. Automatic control systems provide safety interlocks and rudimentary information handling for regulation of the system as a whole and for individual units. The controls are not complicated, often they are no more than a limit switch connected so that a remote signal will indicate when a magazine is full or a part has been rejected.

Standard Components: An appreciation of the potential of equipment integration can be gained from consideration of some of the standardized components used in some typical lines. A piece of equipment is standard for a particular integrated line in the sense that the usual line will have from four to ten similar units that can be standardized. Naturally the design ideas and many of the detail parts can be standardized as in any piece of equipment.

One of the more common automatic materials-handling items used in integrated lines is an automatic float, *Fig.* 1. Individual machines or banks of machines operate at different production rates and are subject to different frequencies and lengths of down time. The floats provide storage of parts between operations. They can receive parts from a processing operation at any rate and at any time.

Abstracted from Paper 123, "Automatic Manufacturing with the Integrated Line," to be presented at the 26th Annual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

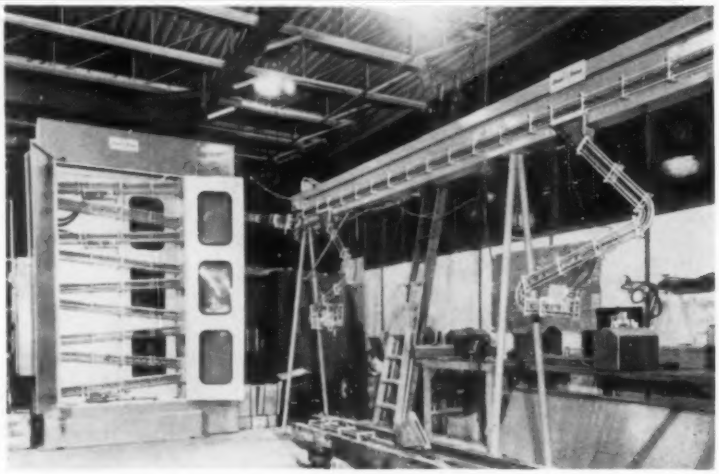

Fig. 1. Storage and distribution system automatically feeds gear blanks to hobbing machines. With this basic system it is possible to feed from two to fifteen machines at a rate of from 200 to 3000 parts per hour.

Likewise, they can furnish parts to succeeding operations at any time and at any rate. For example, a typical integrated line for manufacturing pinion gears would have five to eight automatic storage feeders that will each hold 500 pinion gear blanks or gears. The gears would be maintained in proper orientation so that thrust faces would not slide against any part of of the equipment. The first gear entering the storage feeder will be the first gear to leave the feeder. Part sequence is maintained. In one feeder the parts may move by gravity. Another might be full of moving fluid to push parts and cushion impacts.

Another common item used in integrated lines is the distribution machine which is used to feed a bank of machine tools doing the same operation. The distribution machine receives parts from an automatic float and feeds the individual machine tools on demand. If a machine tool requires a part, the distribution machine immediately supplies a part. This demand of the machine tool is sensed by the distribution machine without interconnection to the machine controls being necessary. The machines in the bank will always have a part to work whenever they so demand.

From the bank of machine tools a simple conveyor collects the parts, maintaining proper orientation, and deposits them in a storage feeder which in turn feeds the following operations or following distribution machines. The demands on the distribution machines may be simultaneous and in effect these demands will be filled simultaneously. Maximum machine utilization is obtained by never ignoring a demand or having a time lag before the demand is recognized and filled.

At the beginning of many lines is another type of device—the bulk storage hopper, *Fig.* 2. This hopper receives parts in bulk, orients them, injects them into the line or into the distribution machines for feeding to the magazines of the first operation.

It is possible to have a sorting gage incorporated with the orienting mechanism of the hopper feeder to reject any blanks that are out of tolerance or do not otherwise meet requirements.

Present Applications: An integrated line now in use automatically manufactures transmission pinion gears at a rate of 900 gears per hour. The raw material is fed into the line at a bulk hopper storage feeder as a screw machine blank. It is ejected from the end of the line as a finished gear.

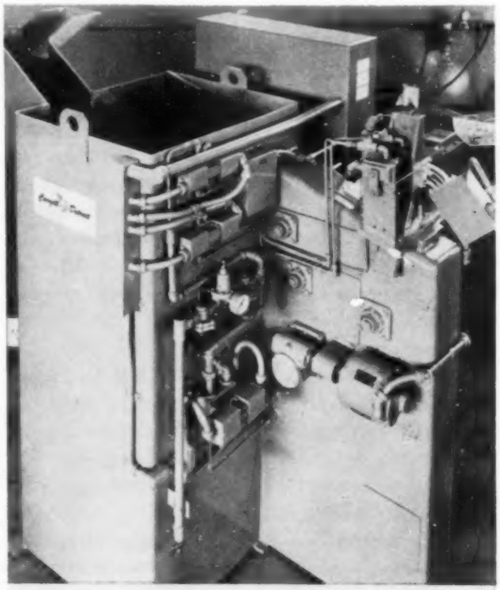

Fig. 2. Bulk storage hopper receives parts, orients them and injects them into distribution machines for feeding to the first operation.

In this line there are 46 machine tools. The hobbing is a particularly critical operation and following every hob the parts pass through automatic inspection devices that check the gears and reject those that do not meet specifications. Upon rejecting a part, this device can also signal the hob to correct itself to compensate for hob wear or to shut down. The automatic floats allow the equipment to be taken off the line for routine maintenance and setup without affecting the operation of the rest of the equipment. None of the equipment in this line is synchronized with any other equipment. The distribution machine feeds one bank of 11 hobs from a float. Machines operate at different random rates. There are times when many of the machines in the line are not needed to meet the production schedule and are simply turned off. The float and distribution machine then automatically do not feed these machines. Their demand has been eliminated and the line may run at a reduced capacity with no adjustment. A gear cannot be put into the line except at the beginning as a screw-machine blank. This blank is inspected for proper dimensions before it is allowed to progress through the line.

Another example of an integrated line manufactures rocker arm shafts. Raw stock enters a storage hopper at the beginning of the line and comes out of the final assembly operation as a completed shaft. In developing this line, two special pieces of through-feed equipment had to be built: a through-feed straightness checker and an automatic assembly machine. Other integrated lines have been built for processing gears, shafts, pins, bearing races, rocker arm shafts, automobile pistons, differential stem pinion gears, crankshafts, hydraulic pump rotors, stators and vanes.

Special Equipment: Most conventional machine tools are available with through-feed, that is, they have magazines for loading and automatic unloading. In integrated lines these magazines will be used except they will not be hand loaded. Some machine tools are not adaptable to through-feed. One example might be a lapping machine that cannot be turned on until it has a full load. Without a full load it will automatically shut off and needs manual reset. For this one point in the line it is necessary to design a special machine. A through-feed straightening machine is an example of such a special machine now in use. This machine has a magazine that is loaded with parts from heat treat. The machine straightens the shaft to a total runout of one and a half thousandths and feeds it into a centerless grinding operation.

Many times the machine that is not available as standard is an assembly machine for use somewhere near the end of the line. For example, an assembly machine has been developed for rocker arm shafts where it is ncessary as a final operation to have a through-feed unit for putting oil seal plugs in each end of a shaft, *Fig.* 3.

Another example of a special machine is a through-feed automatic testing unit for testing a part for strength of braze, *Fig.* 4. This unit handles 1800 parts an hour. The part is a finished hydraulic valve lifter which is gripped on the OD while a 3000-lb load is applied on the push rod seat to check for brazing failure. If there is a failure, the part is ejected from the line.

Advantages of Integration: Integrated lines utilize conventional machine tools which already exist and require no time for development. The

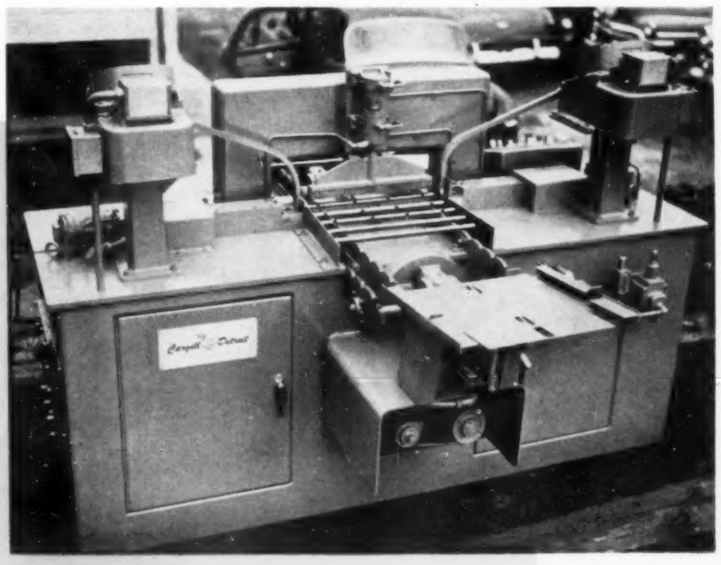

Fig. 3. Special machine built for an integrated line. This machine inserts oil plugs into each end of a shaft.

machine tools are not required to have balanced rates of production and it is not necessary to have them synchronized with each other. Operating personnel are familiar with the machines in use and bottlenecks are quickly resolved. Many familiar cost-reduction programs can be applied with confidence since they have been proved on the individual machines.

An integrated line can be quickly designed, built and installed. Lead time is generally four to six months. Installation of such lines will not disrupt present production because a portion of the equipment can be put in and used while awaiting installation of the balance. As new processing equipment is developed, it can be put into the line or it can be incorporated into the line as replacement for worn-out equipment without affecting the line operation.

The usual figure for the cost of an integrated line is approximately 20 percent more than the cost of the machine tools alone, providing low-cost automation. A less tangible advantage, but one that possibly contributes most to cost reduction, is that the demand system insures complete machine utilization. Whenever a machine requires a part, a part is furnished. Thus, the machine automatically operates at its highest rate of production.

With automatic storage feeders between operations, float size is controlled and large banks of material cannot accidentally build up. Floats are automatically controlled between minimum and maximum limits. Scrap control is excellent. Rejects are brought to the attention of supervision immediately by the automatic inspection and rejection equipment. This prevents additional work being done on a part that has been scrapped by a previous operation.

Specifications: In handling a project involving the integration of equipment in a production line, specifications can be drawn up for the entire line. Throughout the project, the responsible engineer constantly checks equipment components to make sure all of the specifications are met. Some typical specifications are: the system will operate on a demand principle; the line will have no dead stock; there will be no unavailable float; there will be no recirculation of parts; the first part in at the head of the line will be the first part out at the end of the line; a part cannot be taken from the line at any point except after a gage station; and a part cannot be reintroduced into the line at any point except ahead of a gage.

Others are: the line must be capable of handling a number of specified part sizes; a particular part may require handling without sliding; anticoincidence devices or circuits will be employed wherever potential damage to the part or equipment exists; parts in transit will never touch one another; or storage will be provided between each machine. Obviously, the specifications can be tailored to suit a specific line.

The integrated line provides the manufacturer with an approach to problems of production where costs or time prohibit the development and construction of entirely new equipment.

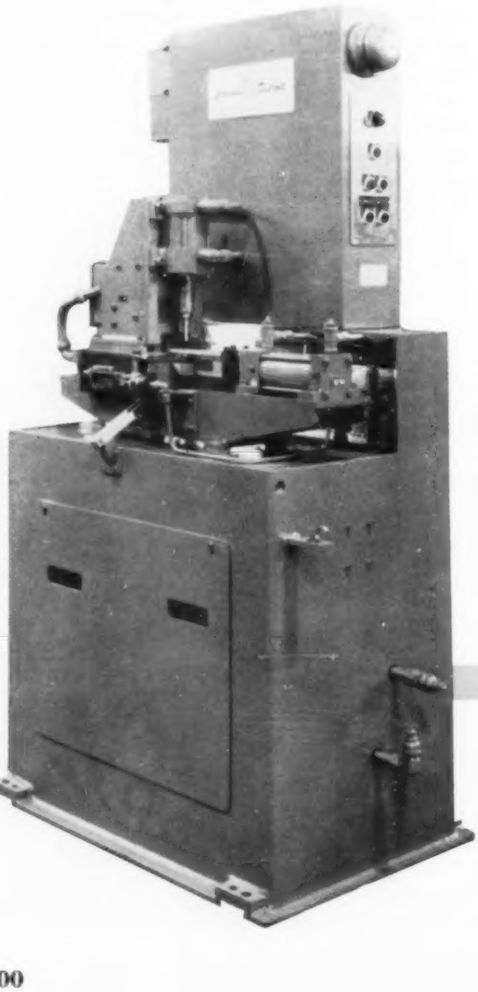

Fig. 4. Through-feed automatic unit testing parts for strength of braze. This unit tests 1800 parts per hour.

coolant filtration
improves product quality

By Virgil G. Drake
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FILTERED COOLANT can be the determining factor between making a profit or loss. An example of the effect on production is illustrated by the application of a filtering system to a gear finishing department which has a battery of ten gear shavers. The problem involved the loss of maintenance and productive time when cleaning metal shavings from the oil reservoirs of the gear shavers.

Each machine had to be cleaned at least once every 24 hours. Cleaning time required approximately 30 minutes per machine during which time the machine was out of production. Operator time, however, was not a complete loss because each operator was responsible for more than one machine. Maintenance labor was an added overhead expense and this factor combined with machine down time was costly.

Plant management, well aware of these costs, had been searching for a satisfactory method of reducing them. Filtration was an obvious answer but conditions were such that satisfactory performance had not been achieved in tests on numerous filters.

The gear shavers, used in the finishing of spur and helical gears, remove from 0.001 to 0.005-inch stock and make several passes, shaving minute particles of the medium carbon alloy carburizing steel. The metal fines thus created are easily compacted and produce a solid mass. Filters under test either became loaded or were unable to remove enough shavings to merit consideration. The heavy viscosity of the oil used in shaving adds to the problem.

A tubular screen vacuum filter was installed for test. As the tests progressed certain flow modifications were incorporated to further improve the operation. The system has a flow capacity of 60 gpm of SAE 250 viscosity oil. Because of the loading properties of the metal fines, the filter backwashes once every ten minutes for cleaning of the screens. A continuous dragout of chain-driven flights, *Fig.* 1, removes settled particles and caked metal back-

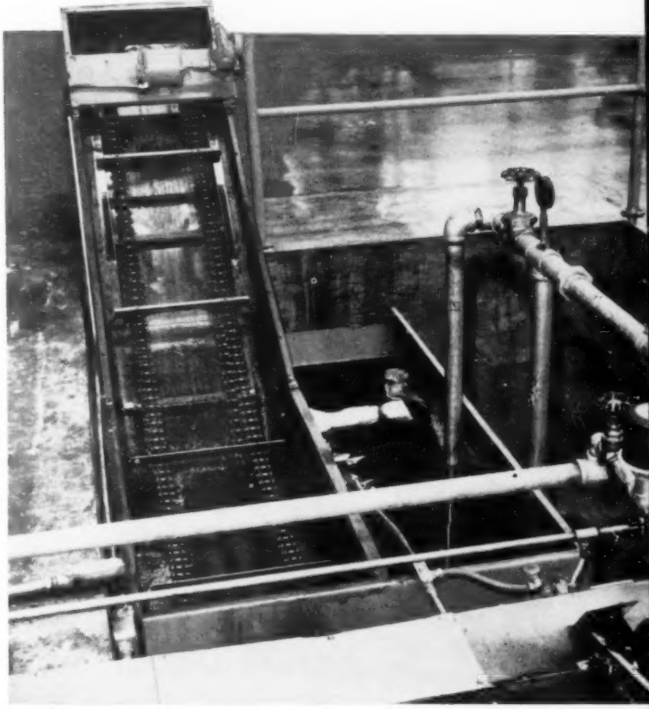

Fig. 1. Filter in pit with drag-out ramp and chain-driven flights for removal of metal fines. Tote box is on far side of conveyor ramp. Spent coolant trough from machine is shown in the foreground entering covered main coolant trough for return to filter. Clean coolant line and individual machine line with solenoid valve for automatic machine flow control are visible above trough. Right side of filter shows clean coolant reservoir.

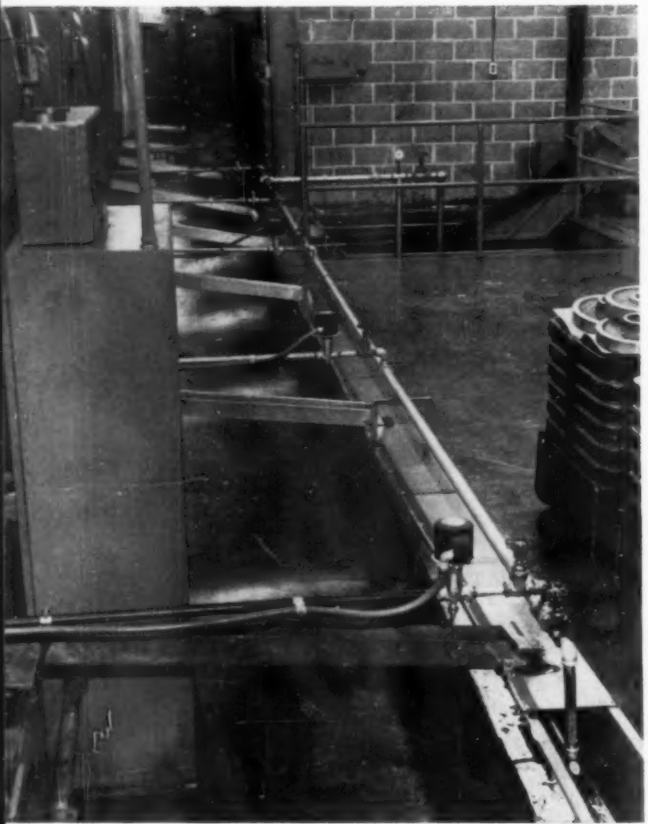

Fig. 2. Rear of gear shaving machine line with filter pit located near the wall to be out of the production area but accessible for cleaning. Spent coolant return trough and clean coolant lines with solenoid valves are positioned parallel to each other for ease of maintenance.

washed from the tubular screens.

The permanent filter central system installation consists of the filter in an open pit. Clean coolant is pumped from the filter in a main supply pipe line. Individual pipe lines to each machine lead off the main line which runs in back of the machines parallel to the spent coolant trough.

Before the filter system was installed, each machine held its coolant in a reservoir. Coolant was supplied to the machine by a pump which was actuated by the master switch. When the machine was shut down for change of work, the coolant flow was stopped. With the elimination of the machine reservoirs and the coolant being supplied from the filter, solenoid valves were installed in the individual machine clean coolant lines to control the flow. The switch which originally controlled the machine pump now activates the solenoid valve. Spent oil is returned to the filter in a coolant trough, *Fig.* 2, fed by smaller troughs from each machine.

This central filter system has been designed for future needs by providing an oil capacity of 60 gpm. Each gear shaver requires three gpm of coolant when operating. The total requirements of the ten shavers now in use is only 30 gpm.

The entire system holds 300 gallons of SAE 250 oil. The only attention required involves the removal of the disposal or filter tote box and addition of oil to compensate for loss due to carry-off on finished parts.

In using this system, other benefits have been obtained. Surface finish on the gears is improved approximately 25 percent and the fine shaving chips do not pack into the serrations of the shaving tool, resulting in freer cutting and shaving action.

Fixture Design Solves Heat Treat Problem

How to heat treat large numbers of automotive steering assembly parts in a single cycle, and how to get longer life from a heat-treating fixture that is exposed to highly corrosive gas atmospheres, abrupt changes in temperature and heavy loads posed a dual problem at Ross Gear and Tool Co. Engineers solved both problems with a high alloy cast fixture of articulated design.

Complicating the problem were the performance requirements. Vertical suspension of heavy, hard-to-handle parts must by maintained by fixtures through eight, ten-hour or longer cycles. Example of the jobs the fixture must do is to support worm type cams during an eight-and-one-half-hour cycle in a carburizing furnace, then for one hour in the furnace while work temperature is equalized, and finally carry the work through a direct quench.

Solution was a fixture designed as a group of individual "leaves" loosely pinned together through box members in the form of a flexible grid. Leaves (some as long as 39½ inches) are cast or type HT alloy—nominally 35 percent nickel, 15 percent chromium, about 0.50 percent carbon with the balance iron and small amounts of silicon and manganese. Fixture leaves in the sectional, articulated design have sufficient strength to sustain loads without need for bracing that would cause distortion from thermally imposed stresses. Slotted hollow box members, cast or the alloy, serve as spacers to keep the leaves properly positioned laterally while permitting them freedom to expand longitudinally. These castings also act as girders to support the leaves when a load is lifted from the furnace for transfer to the quench tank.

Magnesium Tooling Cuts Costs

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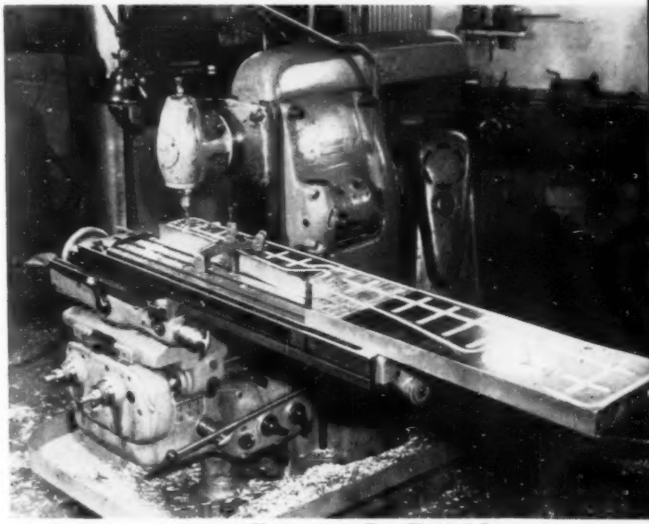

—Photo courtesy Dow Chemical Co.

Fig. 1. Large vacuum chuck being produced from magnesium tooling plate. The chuck will hold large aircraft spars during milling.

Magnesium has come into its own as an economical tooling material. This article points out advantages of magnesium and illustrates many present and potential applications.

MAGNESIUM TOOLING PLATE, extruded bar stock, channels, angles and I-beams are ideal for many tooling applications, *Fig.* 1. The light weight and machinability of the material make it useful for assembly jigs used in aircraft construction, *Fig.* 2. Overhanging jig parts, *Fig.* 3, welded from magnesium tooling plate, provide a rigid locator with an extreme reach without imposing undue loads on the basic structure. Consequently, a lighter and less costly supporting structure is required. Locators that must be placed and removed by hand are much more easily handled when made of magnesium. A magnesium locator, *Fig.* 4, used at Boeing for locating an aircraft door, requires only two men for handling. Construction of other materials would have made the jig awkward to handle with a crane or sizable working party. The light weight of magnesium allows jigs to be stowed easily when not in use and eliminates the need for heavy supporting structures when jigs must be fastened to larger fixtures during use.

Where machining facilities are at a premium, the flat, stable surface of the plate as delivered is extensively used as a reference plane on jigs for aircraft bulkhead sections, ribs, *Fig.* 5, and longerons. Many subassembly jigs are bench type tools and can be handled by one man, facilitating storage and issue.

Other Applications: Magnesium form dies used in forming aluminum and its alloys have long life due to magnesium's wear resistance and non-galling properties. The metal is almost self-lubricating against aluminum and has helped to solve many difficult form die problems. High machinability cuts initial construction and maintenance costs.

A top for a master template table, *Fig.* 6, was made up of two thicknesses of one and one-half inch

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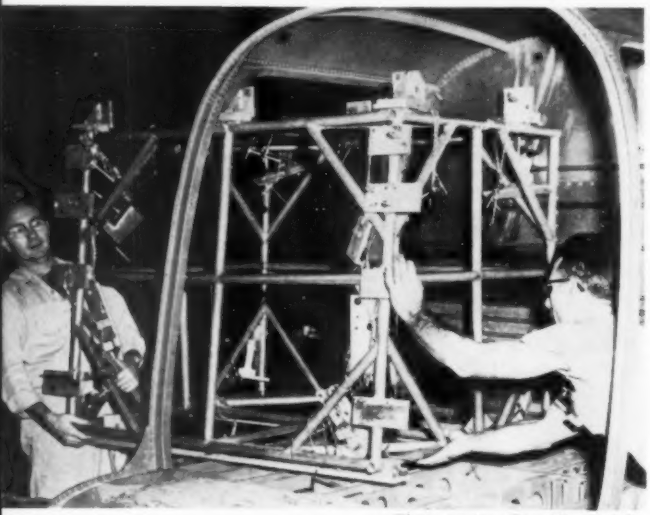
Abstracted from Paper 46 "Magnesium in Aircraft Tooling," to be presented at the 26th ASTE Annual Meeting. Copies of the complete paper will be available for purchase from Society Headquarters.

plate, 4 x 8 feet, with overlapping joints to a size of 20 x 20 feet. The plates required no machining prior to assembly. A considerable saving was realized over the previous construction which was steel and required machining. These tables must remain true and the stability of the magnesium tooling plate has proved itself in this application. Properties of flatness, stability, rigidity and light weight have made magnesium tooling plate an ideal material for plaster form base plates.



—Photo courtesy Dow Chemical Co.

Fig. 2. Magnesium supporting tool frame used in assembly of helicopter cabin. Ease of fabrication and handling led to selection of magnesium.

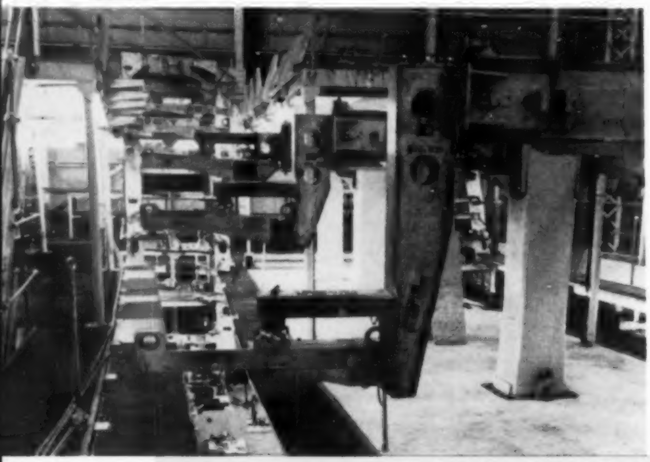


Fig. 3. Wing assembly jig using magnesium. The light weight of magnesium provides rigidity and reduces deflection due to cantilever effects on overhanging parts.

Fig. 4. (right) Door locating jig. Light weight allows easy handling in use.

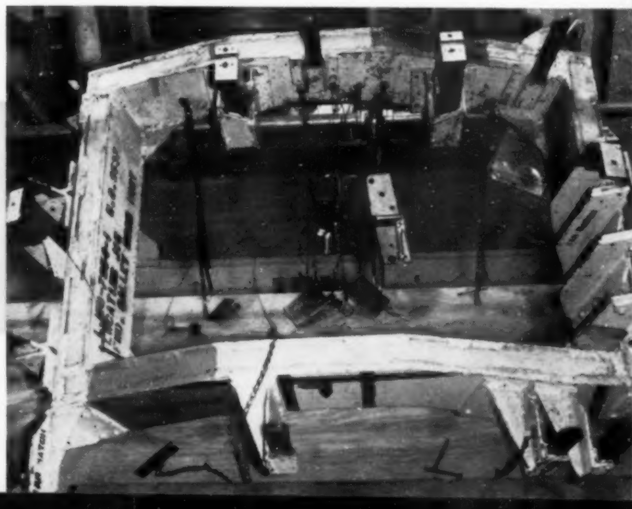
Welding jigs that must be positioned by the operator are easy to handle when made of magnesium. Weld spatter does not stick to magnesium and local heating causes little warpage due to the high heat conductivity. Magnesium, being nonmagnetic, causes no interference when used for spotwelding fixtures.

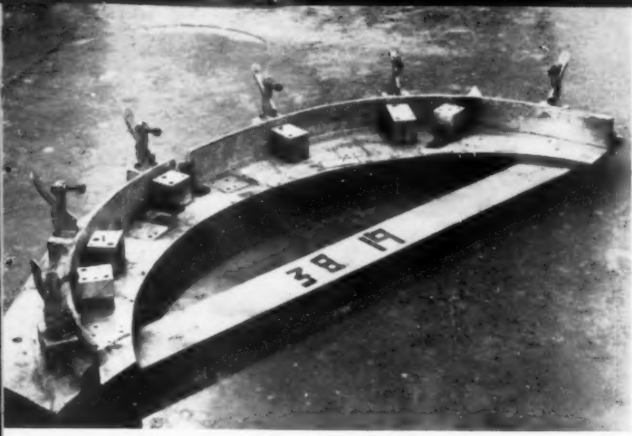
The coefficient of expansion of magnesium is very close to that of aluminum. This property makes magnesium useful for construction of fixtures and gages for checking aluminum parts. A master gage of magnesium, *Fig.* 7, combines lightweight, stability and rigidity.

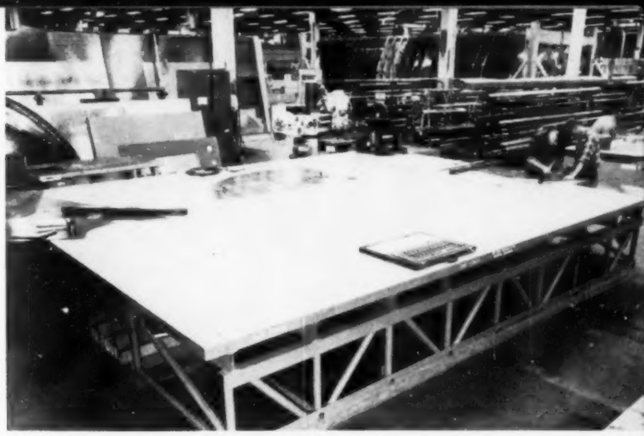
Portable, high reach scaffolding for large airplanes requires a high degree of stiffness in the scaffolding structure to avoid undesirable springboard effects. Fabricated by welding, magnesium alloy channels, angles and tread-plate provide a lightweight but stiff structure. The high-efficiency welds, 95 percent for magnesium versus 55 percent for aluminum, permit a lighter structure as weld reinforcement and gussets are not required. Also, for a given weight of tread plate, the thicker magnesium prevents the springiness characteristic of thinner tread material. Confidence of workmen is enhanced by a feeling of steadiness and stability on the upper portions of four and five level scaffolding. Magnesium compares favorably, costwise, with other scaffolding structural materials.

Welding: Magnesium can be welded with the shielded-arc process to produce welds that are 90 to 95 percent as strong as the base metal. When welding $\frac{1}{2}$ inch magnesium plate to $1\frac{1}{2}$ inch Type A231B-T2 material, torch travel is 40 ipm. For this operation, $\frac{1}{16}$ inch wire is fed at 550 fpm, and argon gas is fed at 30 cfh. The welding is done at 220 amp, 24 v, using reverse polarity (electrode positive).

Welders who are unfamiliar with magnesium have a tendency to use low amperage, making preheating necessary. As welders become more experienced, they learn to work with higher amperages







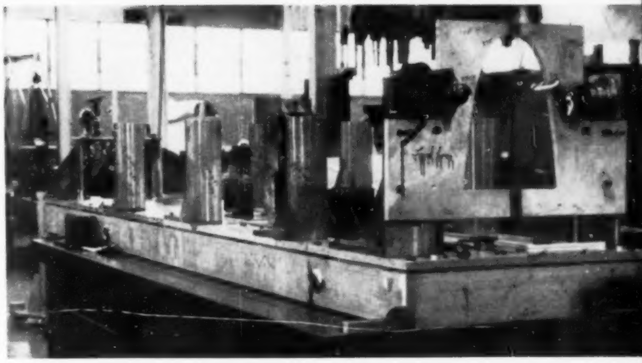


Fig. 5. (above) Rib jig of magnesium. Flat tooling plate provides a good base and reference plane.

Fig. 6. (upper right) Master tooling template table made from magnesium. The tooling plate required no machining and resulted in a saving over steel.

Fig. 7. (right) Master gage for aircraft power-pack strut. Light weight and stability won this job for magnesium.

and to produce sound, neat welds. One exception to the rule that fairly high amperages can be used is the production of concave fillet welds. For these welds, preheating and low amperages give best results.

Machining: Magnesium has better machinability than any other metal in common use, as shown in the accompanying table. Sawing, routing and grinding can be done with woodworking tools. Sawing speeds, using a metal-cutting coarse tooth blade, are the same as those for cutting wood. Contouring is accomplished on a woodworking router at cutting speeds up to 9000 fpm. The cutters should have one-half to one-third as many teeth as are used for cutting steel to allow adequate space for chips. High-speed steel cutters give satisfactory results; however, tungsten carbide cutters are more suitable for extremely high-cutting speeds.

The machinability of magnesium reduces milling time and cost substantially. Roughing cuts should be heavy to minimize heating. Finishing cuts should be made at maximum speed to give smooth surface finishes. Mirror-like finishes can be obtained.

Different drill designs are required for the three types of drilling operations: drilling sheet metal, drilling shallow holes and drilling deep holes. Sheet metal drills have a point angle of 60 deg. The ends of the cutting edge are rounded to produce a smooth finish and reduce burring.

Shallow-hole drills can be of standard design and should be kept sharp to minimize heating. Deep-hole drilling is done with modified standard drills. It is possible to drill holes with depths that are 25 times their diameter without withdrawing the drill for chip removal. For such applications, high-helix drills with polished flutes, with a point angle of 118 deg and a 60-deg spur point are used.

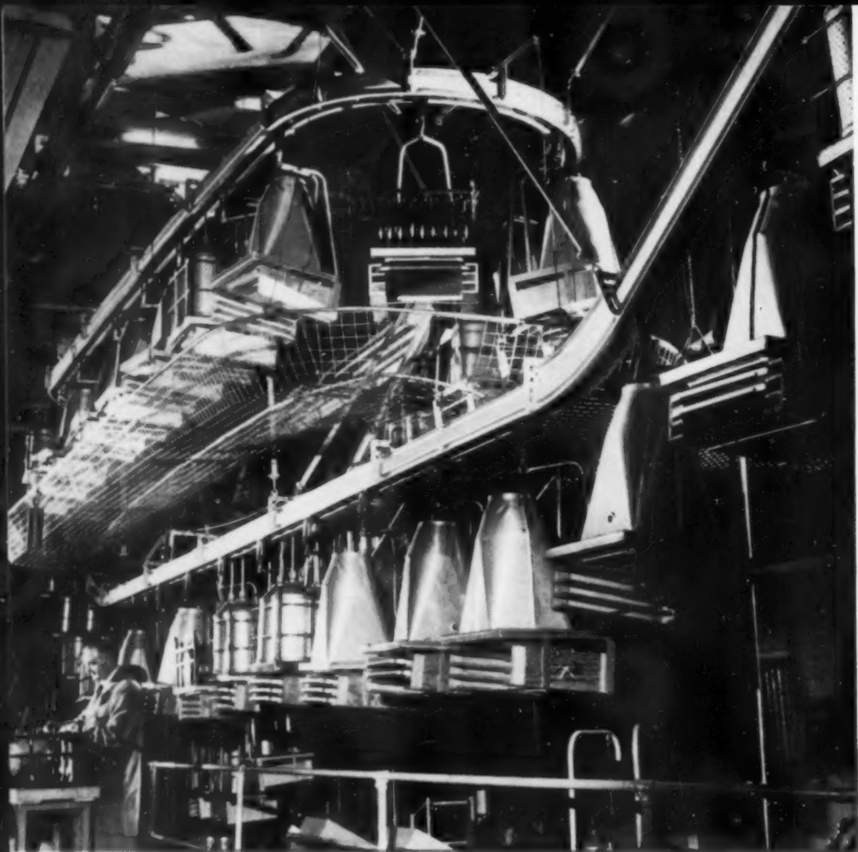
Reamers and taps for magnesium should have fewer flutes than steel cutting tools. Narrow margins minimize springback of the workpiece material.

Grinding of magnesium is usually limited to roughing operations, since the surface finish produced by machining normally does not require further refinement. A coarse grained medium-hard wheel gives best results. Proper dust collection is essential due to the combustibility of magnesium powder. To facilitate dust collection, magnesium is ordinarily ground dry and the dust is removed by a wet type system.

Relative Power Required to Machine Various Metals

Metal	Power Required (ratio)
Magnesium Alloys	1.0
Aluminum Alloys	1.8
Brass	2.3
Cast Iron	3.5
Mild Steel	6.3
Nickel Alloys	10.0

With an inexhaustible supply of magnesium from sea water and more efficient production, the cost of magnesium tooling plate has steadily decreased. In a period where economy is the watchword, an investigation of savings resulting from the use of magnesium tooling plate is justified.



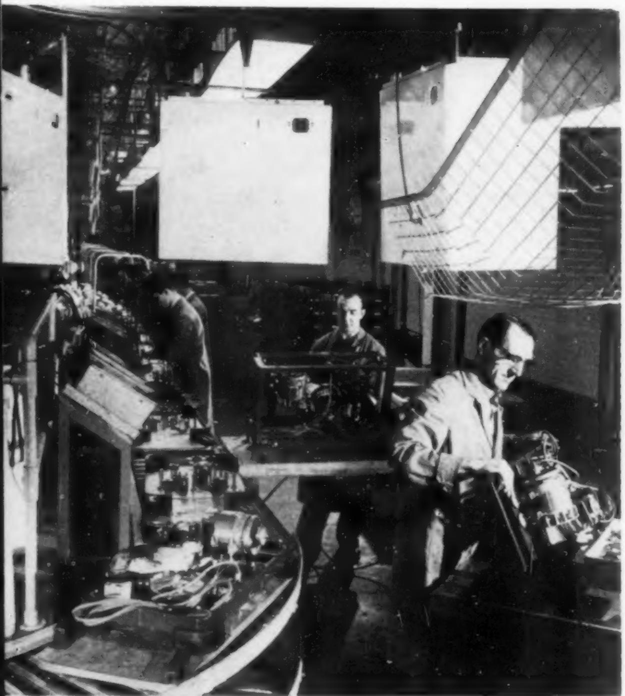
OVERHEAD monorail conveyor at Hoover plant carries washer spin cans, outer cans and dryer lids from finishing plant to assembly area. Safety guards beneath the conveyor eliminate the possibility of injury to personnel or damage to parts if a part drops off the conveyor.

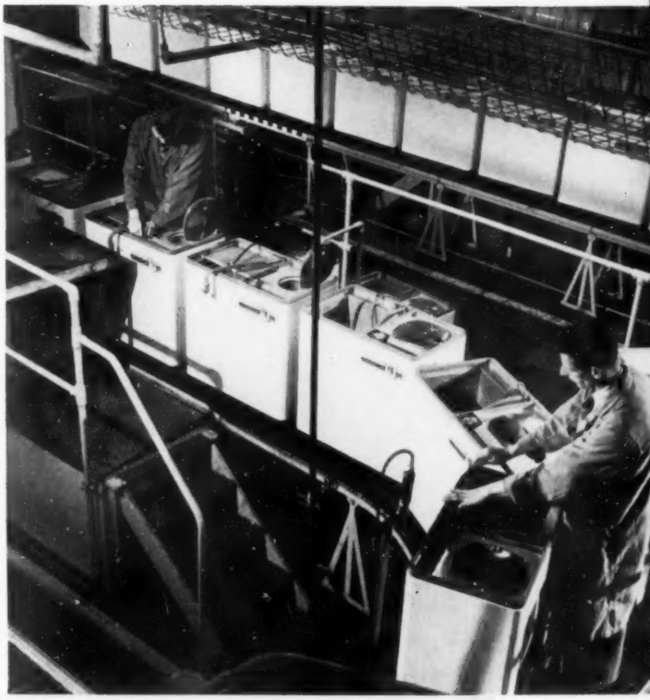
conveyorization

Since the advent of the modern assembly line at the Ford Motor Co. in 1914, conveyors have been the symbol of mass production. The principle of bringing the workpiece to the machine or to the assembly station is the key to successful mechanization or automation. It would be almost impossible to list all of the special types of conveyors that have been developed for specific applications. Some of the most common types—overhead monorail conveyors, power roller conveyors, slat conveyors, chain conveyors and belt conveyors—are illustrated in these pages.

Conveyorization, although an American innovation, is not confined to the United States. An example is the new production line of Hoover Limited at Merthyr Tydfil, Wales. Extensive conveyorization permits continuous assembly and testing of spin dryer washing machines at high production rates. The entire line is designed as an integrated system. Synchronization of feeder lines with the final assembly line and testing lines has eliminated the need for in-process storage of parts or assemblies. Thus the ability of the conveyor system to "keep things moving" is utilized to the fullest extent.

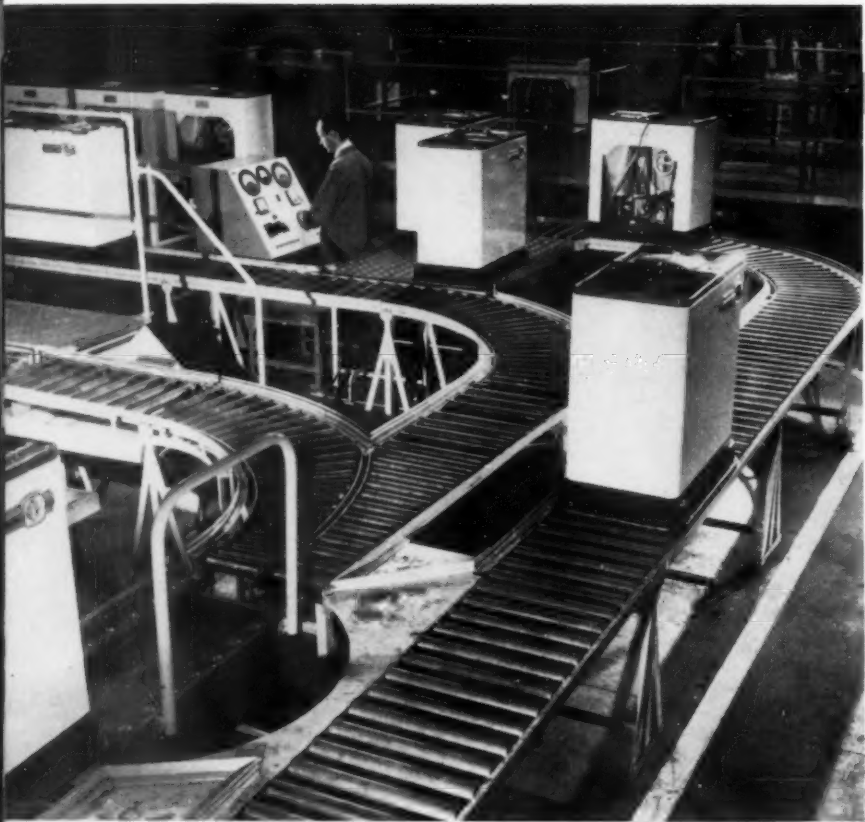
TOOLS at work





WASHER BASE UNITS are built up on pallets that are carried along a roller conveyor. The pallets act as fixtures so that the units can be assembled without any complicated fitting. Unit loads of materials for various assembly operations are stacked along the assembly conveyor.

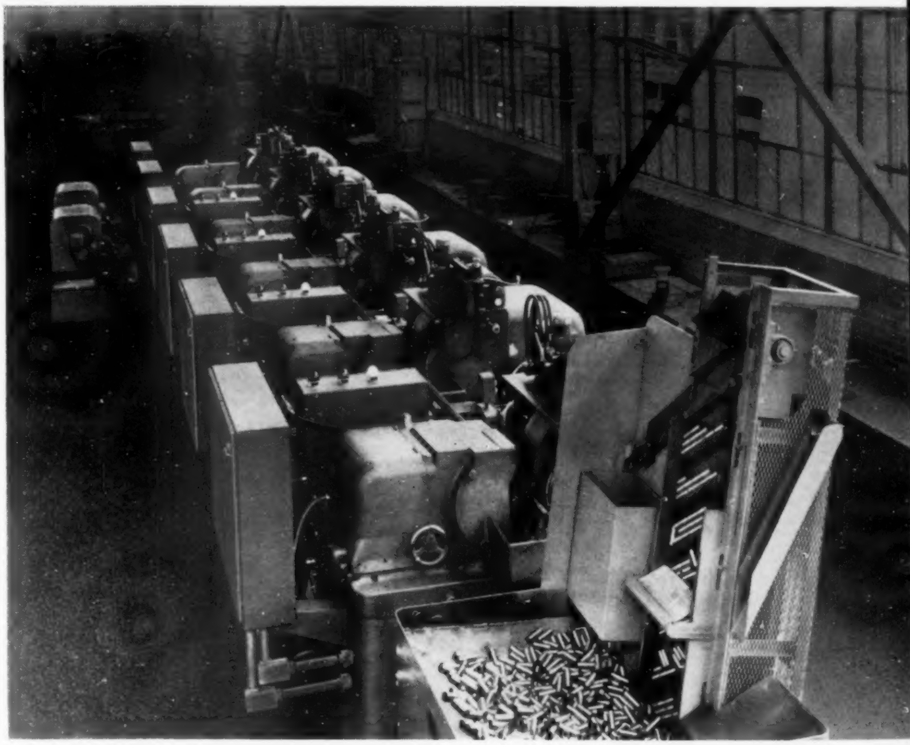
ON FINAL ASSEMBLY LINE in Hoover plant, operators stand on platforms, enabling assembly work to be carried out at a comfortable working height. The conveyor line has been planned so that it is easily accessible from both sides. Twenty-five pallets are recirculated for continuous production.



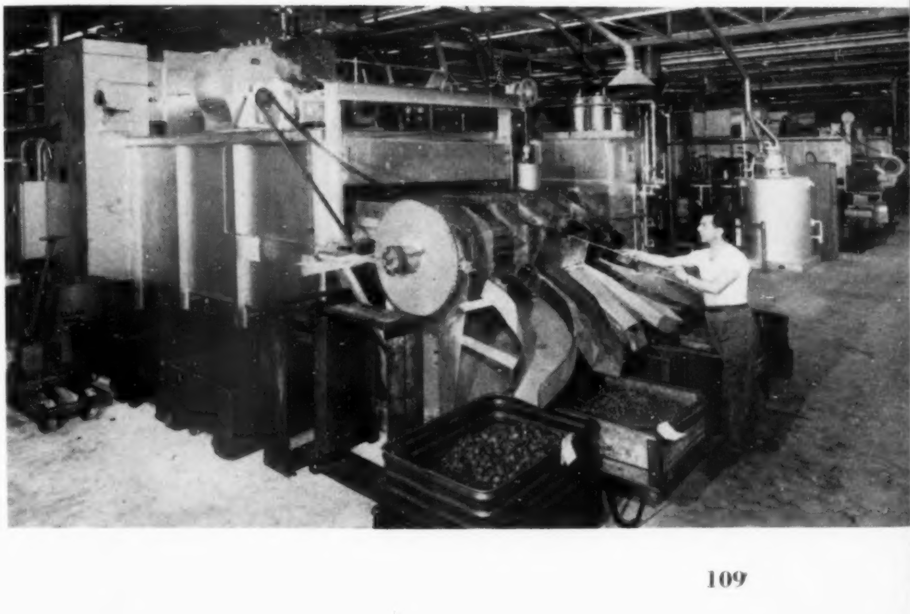
COMPLETED Hoover washing machines pass through test line which runs parallel to the main assembly line. System of shunting devices guides the washers in and out of the test area.

WASHERS pass through the test area on a power-driven slat conveyor. In the first section of the line, auxiliary leads are connected and a resistance check is carried out by the operator. A separate slat conveyor, located above the main conveyor, runs in synchronism with the main conveyor. This second conveyor carries a panel for making electrical connections to each washer under test. On the testing line, the motors are run for seven minutes. Washers are also filled with water and pumped out on this line.

TOOLS at work

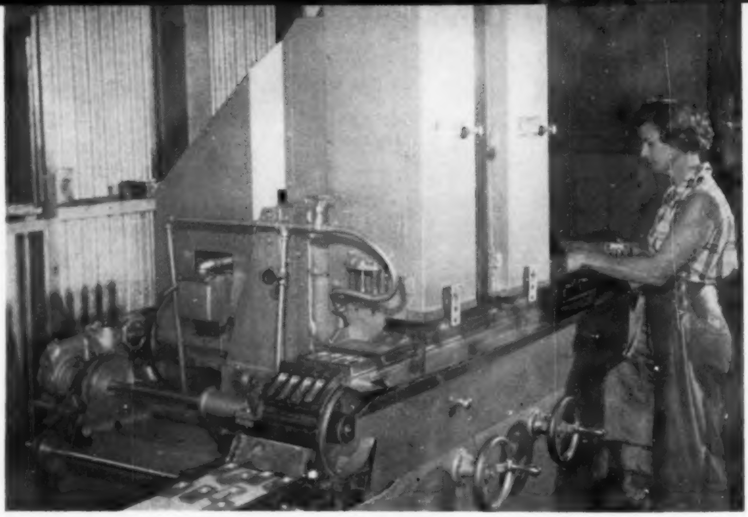


CONVEYORIZATION is applied to the manufacture of piston pins on a centerless grinder line built by Landis Tool Co. Pins are automatically loaded onto a chain type conveyor that carries them through six centerless grinders. A total of 0.008 to 0.009 inch of stock is removed from the pins, with a final tolerance of —0.0002 inch on diameter and 0.0001 inch for roundness and straightness. Each machine is equipped with its own automatic gaging device. Warning lights flash to inform the operator if a piece is over or undersize. Production rate is 2100 pieces per hour.

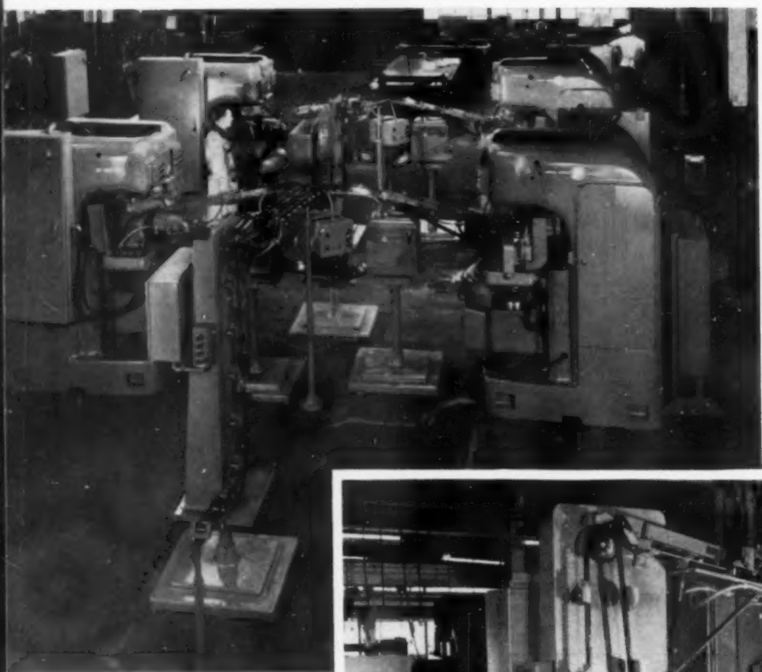


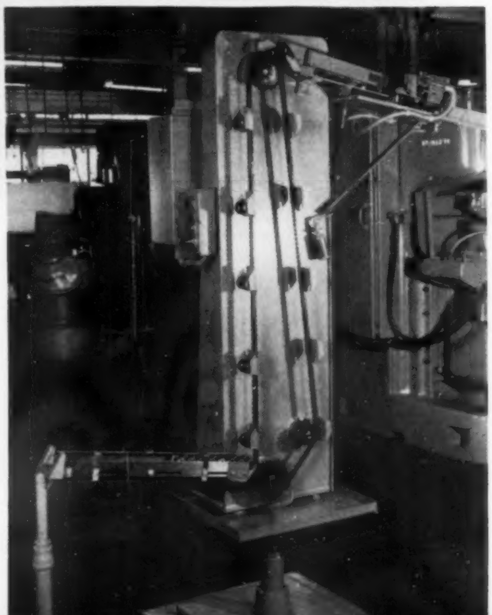
CONVEYORIZATION has converted heattreating from a batch process to a continuous operation. This tempering furnace in the heat treating department of Fafnir Bearing Co. serves six reciprocating hearth furnaces which feed rings into a single tempering unit. Rings are discharged into separate bins. System was engineered by The Austin Co.

Brass escutcheon plates are carried under the heads of a two-head belt grinder by a conveyor belt. Fixtures hold the plates in correct position for roughing and finishing operations. Production rate of grinder, made by Engelberg Huller Co., is 3600 parts per hour.



TOOLS at work





Feed and control functions of four individual gear shaving machines are integrated in a system developed by National Broach & Machine Co. The system is adaptable to a variety of cluster type gears. Gears are fed into the system by a vertical chain conveyor. They then travel to a short chute that is pivoted by an air cylinder control. This pivoted chute can direct the gear into either of two chutes that feed the first two machines in the line. These machines shave one gear on the cluster. The position of the chute is determined by the demands of the machines. As gears leave the first two machines, they are automatically checked and then roll around a curve into buckets on a second chain conveyor that provides intermachine storage. Gears are fed through chutes into the second two machines as needed.

PIPE THREADS
...how to minimize stoplines

By Oscar E. Koehler*
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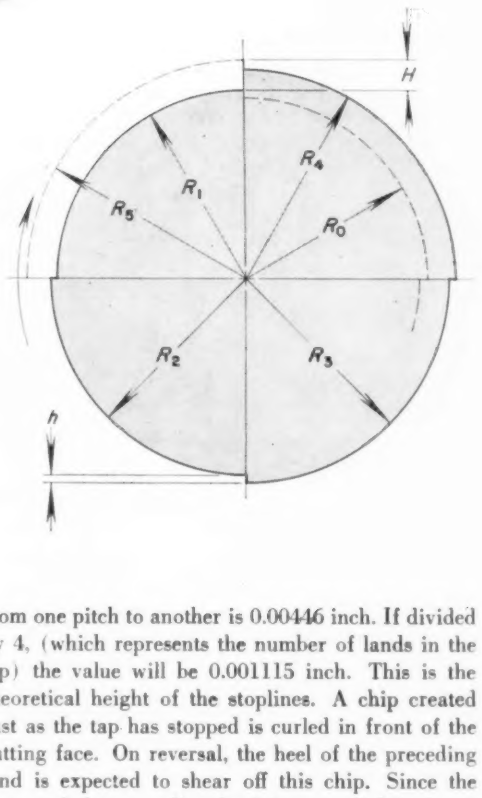


Fig. 1. Sectional view of pipe thread shape. On a four-land tap, the rise in thread in one revolution is *H*; the height *h* is the rise in ¼ revolution, known as the stopline.

Manufacturers using pipe tapping operations as part of their process have often asked, "How can stoplines be eliminated in a pipe thread tapped with a taper pipe tap?" Theoretically, they cannot be entirely eliminated but can be minimized with certain design features incorporated in the tap. However, the height of the stoplines is related to the number of flutes in the tap.

Analyzing a taper thread hole when a ½-14 taper pipe tap has stopped in the hole, the threaded hole is not a true taper, which would make it conical. It consists of four sectors of thread, each being of uniform distance from the center of the hole. The shape of the thread on a ½-14 NPT tapped hole is shown in *Fig.* 1, when the tap has stopped.

On this 14 pitch thread, the difference in diameter from one pitch to another is 0.00446 inch. If divided by 4, (which represents the number of lands in the tap) the value will be 0.001115 inch. This is the theoretical height of the stoplines. A chip created just as the tap has stopped is curled in front of the cutting face. On reversal, the heel of the preceding land is expected to shear off this chip. Since the sector of the preceding land is at a slightly lesser radius, it is self-evident that it can never completely dispose of this step or stopline.

The way to minimize this stopline is to hand tap for about one turn with a tap having as many lands as possible in the tap. Generally, this tapping is done with a tap having an odd number of lands to prevent synchronizing with the stoplines left by the tap used previously. Thus, if a seven-land tap were used for the hand tapping operation, the theoretical height of the stopline would be 0.000637

*Senior member ASTE Northern Mass. chapter.

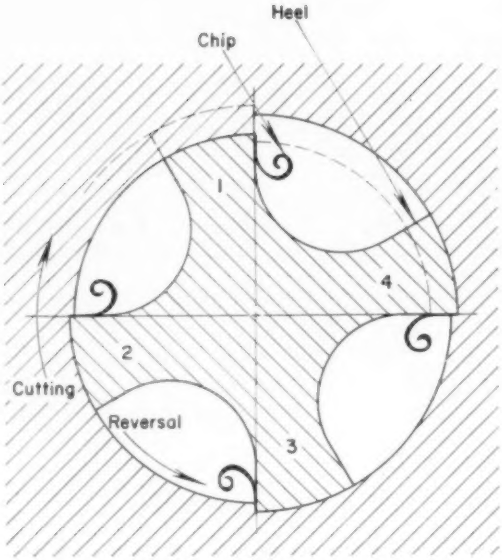


Fig. 2. During the tap reversal, the heel of the tap land preceding the cutting edge must shear off the chip in front of this edge.

inch. When used in soft metals like brass, the tap practically smooths out the stoplines.

If a spiral fluted tap is used for the hand tapping operation, it will still leave the same height of stopline as a straight fluted tap of the same number of lands but the stoplines will be in the form of a spiral. On certain metals which might be used for connections, it is probable that a straight row of stoplines on the external pipe might smooth out a spiral row of stoplines in the internal coupling more readily than they would if the internal coupling had a straight row of stoplines.

This may be a little difficult to explain but, if a straight row of stoplines on the external thread can be visualized coming in contact with a similar straight row of stoplines in the internal fittings, it can be seen that the blow is severe, and a row offers more resistance to removal. However, with a spiral row of stoplines, the straight row shears off one thread stopline after another instead of an entire row, thus making the operation a gradual one. It could then be assumed that a spiral fluted pipe tap for the hand operation might have a slight advantage over a straight fluted tap.

It is doubted that a seven land spiral fluted tap would produce a better fitting than a seven land fluted tap because a new problem enters the picture, namely, the difficulty of preserving correct taper. The design of the tap will vary considerably with the kind of material being tapped.

The only way to completely eliminate stoplines is to taper thread the hole with a single pointed tool or thread mill the hole with a multiple thread milling cutter. Even the latter method may produce one stopline or a slight line of demarcation where the cutter finally terminates the contact.

The ultimate question of interest to all users of pipe taps is: "How does the pipe joint stay tight?" The answer is that the materials used are sufficiently deformed in the makeup of the joint so that the external and internal threads conform to one another regardless of the final shape assumed.

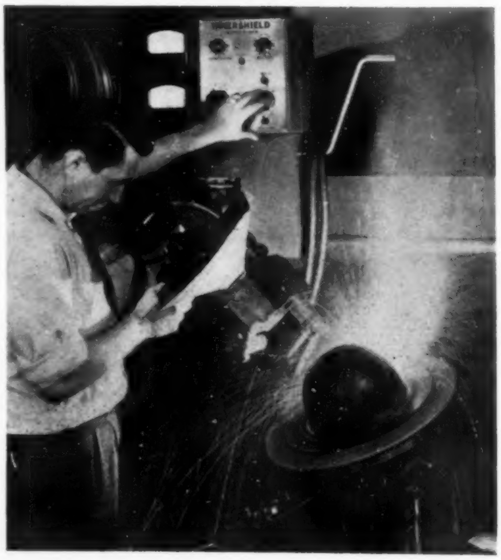
High-Speed Process for Quality Welds

Welding speeds ranging up to 300 ipm are being achieved through a process called "Innershield."

The automatic technique, introduced by The Lincoln Electric Co., uses a flux-containing, coiled wire electrode that produces a vapor shielding for an open arc. Speeds in 14-ga steel lap welds in the horizontal position range around 150 ipm. Lap welds in heavier material, such as 3/16-plate, range around 100 ipm.

In operation, a visible arc is maintained between work and the continuously fed electrode. The arc melts both work and electrode, the metal electrode serving as filler metal. Some of the electrode's flux ingredients vaporize in the arc and shield it from the surrounding air. Other ingredients go into the molten pool to act as fluxing or deoxidizing agents. Resultant weld is free of heavy slag.

Equipment includes a welding head that controls electrode feed and a motor generator power source that supplies 400 to 1000-amp welding current.



milling practice today

By A. O. Schmidt
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and
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Even with machining practice at the degree of refinement that it has attained, automation and competition are eliciting further improvements. Mighty engines in airplanes and all sorts of power generating machines exemplify a basic change that has occurred in recent years; namely, that more power is generated in a smaller space. A similar situation exists on the production line, created by the demand to machine more workpieces in a shorter time within a given floor space. When productivity must be increased, the milling machine and cutter frequently come under consideration.

Industry is demanding higher production rates and tool materials and tool designs which will operate efficiently at these higher rates. This demand often raises power requirements and necessitates more rigid machine construction.

New Materials: Some workpiece materials machined today have formidable properties. Because of machining problems, no attempt was made to mill these materials until recently. Some of these metals and alloys were not available in production quantities a few years ago. This situation necessitates a certain amount of metal-cutting research and also requires production men to use an engineering approach. Manipulation of the tool design, or the speed and feed rate, often is not sufficient to mill a new job with optimum effectiveness. Superficial changes may result in breakage of tools and damage to workpieces or even machines.

Today high-powered milling machines and cutters have greater capabilities than those of the past, but they must be employed correctly. Part of the answer of better utilization lies in understanding, applying, and extending sound tool engineering. More pertinent metal-cutting information is needed and, fortunately, is available. In various laboratories a search is constantly pursued for information to lead to better milling and machining practice generally, as well as improved machine tool efficiency. A great deal of scientific metal-cutting data already exists that, when finally established as valid, will help to produce better work on the production floor.

Cutting Speeds: In many milling operations higher cutting speeds are possible or demanded. Improved tool materials such as the new carbides and ceramics permit faster machining because of their capacity to retain a higher degree of hardness at elevated temperatures. When using higher milling speeds certain points should be taken into consideration. Metal-cutting is inherently of a particular interrupted nature in milling. An individual milling cutter tooth during each revolution is engaged with the workpiece usually much less than one half of the time. Thus, each tool tip has a substantial chance to cool when not in contact with the workpiece. It is, therefore, often possible

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in milling to use greater cutting speeds than in turning the same work material. On the other hand, milling is accompanied by repeated impacts or shocks upon entry of the cutting edges into the workpiece and this often can cause breakage of the cutter. Use of a more shock-resistant grade of carbide often can eliminate such breakage.

Power required in a metal-cutting operation is of basic interest. Under certain conditions tool forces may be reduced at high cutting speeds; e.g., the tangential cutting force may be reduced 30 percent when increasing the cutting speed for steel from 150 to 800 fpm. At the same time that the tool starts to cut, however, it also begins to wear. This wear progresses at a more rapid rate at higher speeds. Progressive wear is usually accompanied by a continuous increase in the magnitude of tool forces. Tool forces increase more rapidly with cutting time at high cutting speeds, *Fig.* 1, and the gain possible through initially lower cutting forces at higher cutting speeds is soon lost due to more rapid tool wear.

Since an increase in cutting speed itself usually requires a proportionate increase in power, the question of available horsepower must be considered. It is not good practice to start machining with loads over rated motor capacity, because, during the life of the tool between grinds, progressive wear or dulling will usually require progressively greater power.

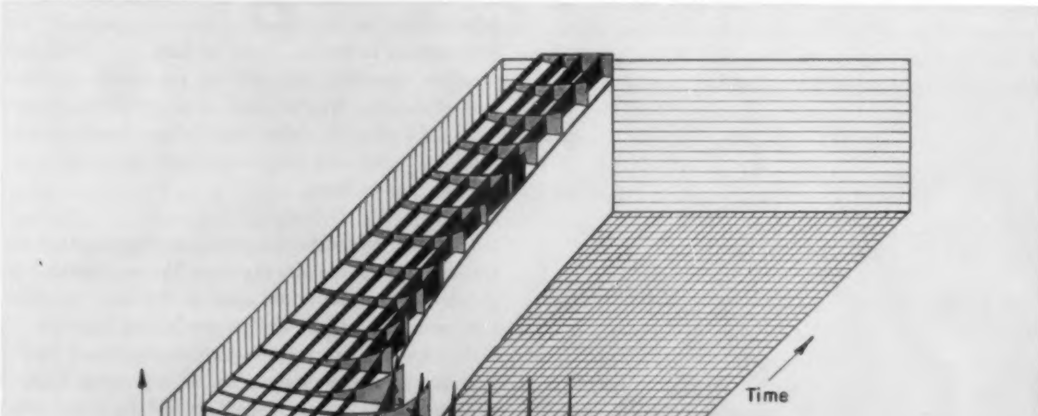
Fig. 1. Cutting force as affected by speed and wear or cutting time. This is a typical situation in which the tool force decreases with higher cutting speeds but increases with progressive wear. Tool life is reduced drastically at the higher cutting speeds and the advantages of reduced cutting forces with a sharp tool are quickly lost due to wear. The boundary of the solid figure describes the limit of economical tool life.

Tool Temperatures: Much of the energy expended in a metal-cutting operation is lost as heat. One horsepower is equivalent to 42.41 Btu/min. and, althought only 5 to 15 percent of this heat appears in the tool, depending on the cutting speed and other conditions, it is still a large amount of heat to be accommodated in the tool. Since the area of heat input or the area of contact of the tool with the chip and workpiece is small, the tool temperature is high in a zone near the cutting edge. Tool-tip temperature in a typical steel cutting operation may range from 1400 F at 400 fpm to the melting temperature of steel at cutting speeds above 6000 fpm.

Much controversy has arisen from a cutting speed-temperature relationship proposed by Salomon. It is often stated that tool-tip temperatures and the associated rate of tool wear first increase with increasing cutting speeds, reach a maximum and then decrease again with still higher cutting speeds.

Salomon showed experimental data to support this contention. He enjoyed high repute in the field of metal-cutting and, naturally, his sensational theory created a great deal of interest.

Salomon used the tool-work thermocouple technique to measure cutting temperatures at high cutting speeds. The emf generated in a thermo-



couple will decrease when the melting temperature of one of the conductors is reached. Dr. Salomon incorrectly associated this drop in emf with a decrease in cutting temperature. In reality, a true thermocouple no longer existed and true temperature measurements at this point could not be obtained. The question of instrumentation in machining tests and the proper interpretation of data taken with such instruments is of prime importance.

When a milling cut is light and short, it is possible to mill at cutting speeds high above those usually recognized as practical. When a milling cut involves a comparatively long contact between chip and tool, for example, in face milling a workpiece six inches wide at one-half inch depth of cut, then the cutting speed must be much lower than when taking a short and shallow cut on a small surface with a large-diameter slab or plain milling cutter.

A stream of coolant applied to a carbide cutter when milling steel will usually cause spalling and chipping of the cutting edge. The tool repeatedly attains a high temperature in the cut and is subsequently subjected to a quenching action by the coolant causing a temperature oscillation too extreme for the tool material. Application of a mist coolant causes less drastic effects and improves tool life of a carbide cutter.

Milling in Automation: Frequently, milling must be considered as part of an automated process involving a number of milling stations in conjunction with other machining operations in a line of machine tools. Under such conditions tool life and related factors assume great importance because of their over-all economic effect.

Often tool life of cutters varies widely from one lot to the next, even with strict metallurgical control of tool and workpiece materials. This is caused by the lack of uniform cutter grinding procedures which become an absolute necessity if the over-all efficiency of a row of automated machine tools is to be maintained or increased.

Chip interference in the tool proper or welding of the chips to the cutting edge frequently causes tool breakage and often can be eliminated by improved tool design or tool materials, application of a cutting fluid or surface treatment of cutters; e.g. oxidation of HSS cutters. Because of chip interference, generally encountered when machining ductile metals, the majority of automated machining operations are limited to cast iron. It is possible, however, to design a tool that will produce short chips even when machining steel and other ductile materials. The successful solution of this problem either through metallurgy or cutter design will open up an entire new field for the application of milling machines in automation.

Designing for Efficiency: It is not uncommon that the dimensions of castings are much larger than specified. Such excessive stock can cause cutter breakage. The tool engineer may be able to reduce or eliminate such cutter breakage by designing stronger tools. If these difficulties are anticipated they should be given consideration while the tools are being designed initially; otherwise it may be impossible to redesign the tools for optimum performance under the conditions of automated production.

Dimensional variation in the workpiece will affect the power requirements and greater depth of cut or higher feed rates will increase nearly proportionately the power demand at the spindle. Tool wear can increase the power requirement by as much as 50 percent, and sometimes even more. Some reliable indication should be utilized to recognize permissible limits of tool wear in relation to workpiece accuracy obtainable, wear on the tool itself or changes in power demand.

No machine tool should be started initially with an overload. There should always be a horsepower

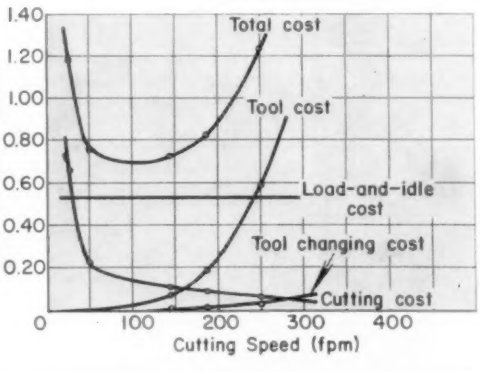


Fig. 2. Production cost in relation to cutting speed when turning a high-strength cast-iron, ten-inch-diam pulley with brazed, carbide-tipped tools.

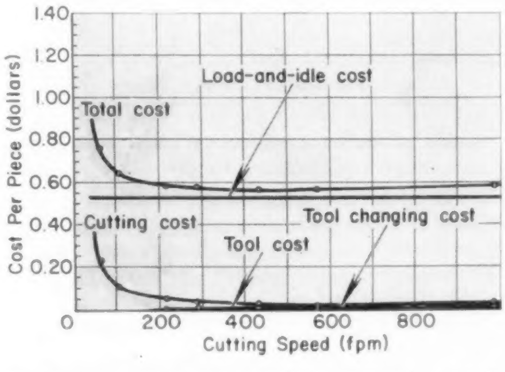


Fig. 3. Production cost in relation to cutting speed when turning a high-strength, cast-iron, ten-inch-diam pulley with mechanically held ceramic-tip tools.

reserve to take care of any increase in power demand, whether due to differences in workpiece dimensions or material, dulling of cutters, or even momentary overload caused by "hard spots." Even if the cutters should not break, continuous overload on the machine shortens tool life.

Scale or sand inclusions create a problem in each individual workpiece. The optimum cutting speed and feed and the most suitable tool materials, tool angles, and sequence of operations often can be determined only by tests with the actual workpiece. Generally, the machining of hard workpieces requires milling cutters which have a rigid body with movable or removable blades positioned so that the major wear areas can be efficiently reground or the blade can be readily and accurately replaced or indexed. This design will also eliminate weakening of the cutter body when regrinding the teeth repeatedly, since the grinding wheel need not touch the body of the cutter. For general purposes brazed carbide-tipped cutters have performed satisfactorily. Gaging, checking, and changing of tools should be provided for in a way not requiring long shut-downs of a line of machinery.

Workpiece design must be adapted to automation of the machining process and tool design, along with tool changing and regrinding, must be given primary consideration rather than be treated as an afterthought. To be really economical, automation with the use of machine tools includes not only efficient materials handling but also special tool engineering to keep tools working continuously.

It can be seen in *Figs.* 2 and 3 that there is a considerable cutting speed range for minimum or near minimum per-piece cost. Higher cutting speeds possible today, when used in a simple independent machine, do not permit savings beyond a certain point, because load-and-idle cost remains constant and often constitutes the largest part of the total machining cost.

If a number of machine tools are arranged in sequence for machining the same workpiece it is possible to reduce machining cost. Because of the interdependence of machines in such an arrangement, the optimum cutting speed range becomes narrower as the number of interrelated machines is increased. Cost per piece can rise very rapidly because of increased cutting cost if the cutting speeds are too low, but cost will also rise above an economical point because of increased tool and tool changing or down-time costs if cutting speeds are too high. In any case the amortization cost for machine aggregate is relatively high. Such cost can be justified by sufficiently high production at low cost per piece.

Outlook: The trend to high-strength alloys requires more engineering in machines and tools. As yet there are no valid indications that it is possible or feasible to use the high cutting speeds we are accustomed to employ for light metals for machining high-strength steels and alloys utilized in aircraft or missiles.

Challenges to the tool engineer are displayed in the trend toward automation and the introduction of tape-controlled milling machines. Because of high investment cost these must be used at optimum cutting speeds and feeds.

Considering the factors affecting machining cost, practical cutting speeds for milling operations in a multiple station machine occupy quite a limited range. Great savings are possible when the optimum cutting speed or machining time is established and maintained. Continuous and diligent attention to all fields of machining is required if adequate information is to be obtained to reach this goal.

Close Shaves with a Rotary File

In today's high-speed aircraft, drag of driven rivets that protrude as much as 0.010 inch above the skin is extremely critical. With aluminum and magnesium rivets, industry simply uses a standard mill adapted to fit a special air motor. This technique, however, will not work with titanium or stainless steel. To cope with these metals, Boeing Airplane Co. developed a tool consisting of a standard one-inch arbor type tungsten-carbide rotary file mounted in a quarter-inch portable air drill motor in such a way that the cutter rotates in two axes. An adjustable threaded housing controls closeness of the shave.

NONSTICKING PLUGS

for jigs and fixtures

By J. R. Paquin*
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Locating pins for jigs and fixtures can be made nonsticking. This article proposes a set of design dimensions for general-purpose use. The dimensions can be modified to suit other applications.

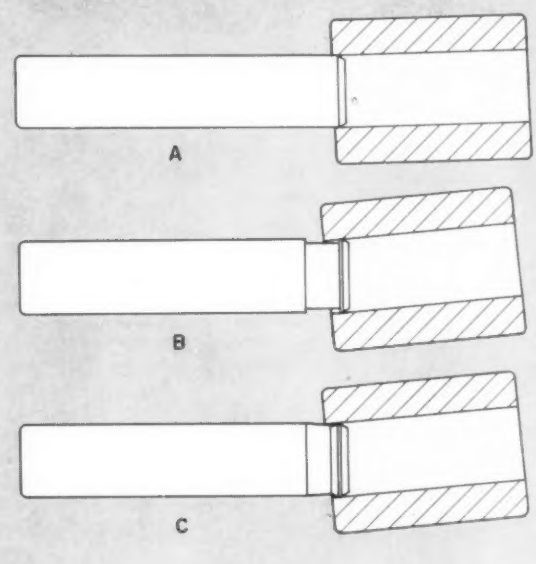

Fig. 1. Plug at *A* sticks when inserted in hole. Relieving end of plug as in *B* allows plug to enter hole without sticking. Design is further improved at *C* with addition of gradual lead angle which facilitates locating.

When a part has a relatively large hole or opening, it is considered good practice to specify the machining of this hole as the first operation. A suitable locating post is incorporated in the design of jigs and fixtures for all subsequent operations, and engagement of this post with the machined hole accurately positions the part.

This method has one serious disadvantage—that of sticking or binding of the part in the first stages of engagement over the locating post, as shown at *A* in *Fig.* 1. The part, a round sleeve, is applied over a locating post. Sticking occurs until the part has sufficiently engaged the post for complete alignment. The reason for sticking and locking is the difficulty of aligning the parts. Severity of binding and locking increases as clearance between parts decreases. For close-fitting components, such jamming adds considerably to the time required for loading jigs or fixtures, in addition to being a source of annoyance for an operator. A chamfer on the plug helps in centralizing the part, but does not decrease the amount of sticking, or jamming.

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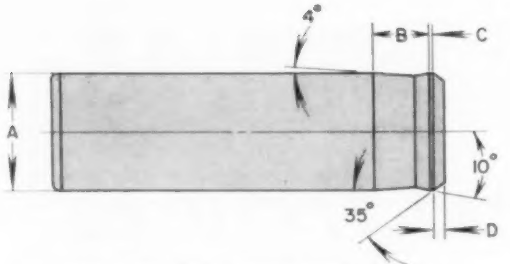
Shown at *B* is a method of eliminating sticking. The post is relieved, leaving a narrow pilot ring at the front. The pilot diameter remains the same as the post size. The part is thus free to rock axially over the pilot until the shoulder is reached. Alignment distance between shoulder and pilot is made long enough to eliminate binding. However, some time is lost in aligning both pilot and shoulder.

The modification shown at *C* eliminates this



DIMENSIONS FOR NONSTICKING PLUGS

A	B	C	D
¼	0.117	0.004	0.023
½	0.234	0.007	0.046
¾	0.351	0.011	0.070
1	0.468	0.015	0.093
1¼	0.585	0.018	0.116
1½	0.702	0.022	0.139
1¾	0.819	0.026	0.163
2	0.936	0.030	0.186
2¼	1.053	0.033	0.209
2½	1.170	0.037	0.232
2¾	1.287	0.041	0.256
3	1.404	0.045	0.279
3¼	1.521	0.049	0.302
3½	1.638	0.052	0.325
3¾	1.755	0.056	0.349
4	1.872	0.060	0.372
4¼	1.989	0.064	0.395
4½	2.106	0.067	0.418
4¾	2.223	0.071	0.442
5	2.340	0.075	0.465
5¼	2.457	0.079	0.488
5½	2.574	0.082	0.511
5¾	2.691	0.086	0.535
6	2.808	0.090	0.558
6½	3.042	0.097	0.604
7	3.276	0.105	0.651
7½	3.510	0.112	0.697
8	3.744	0.120	0.744
8½	3.978	0.127	0.790
9	4.212	0.135	0.837
9½	4.446	0.142	0.883
10	4.680	0.150	0.930

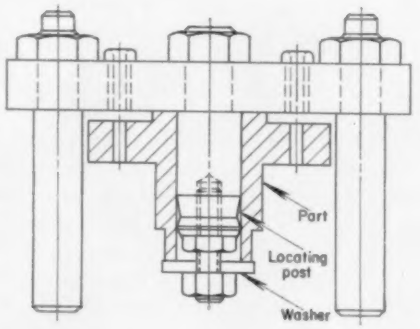
difficulty, and represents the ideal method of removing sticking and binding between any locating post and hole. In addition to a relief groove, the post has a tapered lead to align the part hole with the locating post. Although this is a simple and inexpensive modification of the post, the resulting action is startling in its effectiveness. With the post altered in this manner, the part can be applied over it just as fast as an operator can load, no matter how close-fitting the parts may be.

Illustrated in *Fig.* 2 is the front view of a typical plate jig used to drill holes in the flange of a round part. For loading, the jig is inverted and the part is positioned over a locating post and locked with a C-washer and nut. Sticking in initial engagement of part over locating post—a common problem with such drill jigs—is eliminated by designing the post as described. The groove makes the drill jig completely jam-free.

Proportions for machining locating post ends to provide bind-free operation are given in the accompanying table. This table allows the tool designer to apply dimensions quickly to drawings. Dimensions for proper functioning of the one-inch post were established by experimentation at Standard Die Set Co. Dimensions for the other sizes were worked out by proportion. These values will provide completely nonsticking pins. If locating length is critical, the length of groove can be decreased. Of course, this modification will result in a less effective design. Formulas for calculating dimensions of plugs for specific cases were discussed in "How To Design Nonsticking Plugs and Rings," The Tool Engineer, Feb. 1956.

In plants where the nature of manufactured parts is such that locating posts are used frequently, they may be standardized by number. The designer can then specify a number on the drawing, and the toolmaker machines the post end to dimensions given in the table.

Fig. 2. Typical plate jig for drilling holes in part flange. Part slips on locating post easily and speeds production.



Brazing Filler Metals

...for high-temperature service

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INCREASING SERVICE temperature requirements imposed on brazed assemblies for rocket and jet engine parts, as well as for a growing variety of industrial equipment, has focused much attention on newer types of filler metals to make dependable joints in heat-resistant alloys on a production basis. Some of the brazing filler metals which are showing the greatest promise for these high-temperature requirements are shown in the accompanying table.

Silver-Base Lithium Alloys: Recent research performed at the Armour Research Foundation under the sponsorship of the Lithium Corp. of America has demonstrated that lithium makes an important contribution in filler metals for brazing heat resistant alloys. This research, now confirmed by industry experience, shows that the addition of a small percentage of lithium markedly improves the fluidity and wetting ability of many standard alloys. Thanks to the lithium modification, it is now possible to braze stainless steel in an atmosphere, without flux, at temperatures as low as 1600 F.

The lithium alloys typically contain 0.2 percent lithium. One such filler metal—sterling silver with lithium—is rapidly gaining favor for brazing honeycomb panels made of 17-7 PH stainless steel. Its flow temperature corresponds to the temperature for proper heat treatment of this metal, and the joints retain a tensile strength of about 35,000-40,000 psi at 900 F (short-time test), which is the maximum service temperature for 17-7. Furthermore, the filler metal readily wets in vacuum, dry hydrogen, or inert gases, without flux.

Because of its high fluidity, this silver-copper-lithium filler is very advantageous for penetrating small gaps between the components of the brazed sandwich, and it represents a marked improvement over silver-manganese which does not easily wet 17-7 PH steel. Joints of sterling-lithium alloy are more corrosion resistant than those of silver-manganese. It is reported that the use of this lithium alloy in place of silver-manganese has reduced the reject rate on brazed honeycomb sections from 45-50 percent down to less than 10 percent. However, the high fluidity of the alloy has been found objectionable on large, curved surfaces because of excessive runoff of the molten alloy. New developments are currently under test to overcome the problem.

Other fillers in which the addition of small amounts of lithium has proved advantageous are the silver-copper eutectic, AMS 4772, and silver-manganese (85-15). These materials are being used for brazing stainless steel bellows, instrument assemblies, hydraulic lines and a variety of jet engine parts.

Another development is the silver-lithium binary, containing 2-3 percent lithium. This alloy has shown considerable promise for brazing titanium and its alloys. Peel strength is not yet satisfactory

From a paper delivered at the 1958 Midwest Welding Conference sponsored by the Armour Research Foundation, Chicago, Ill.

for some applications, but work is under way to improve this property.

Silver-Palladium and Silver-Palladium-Manganese: Palladium additions to silver increase the melting temperature, the strength, and the ability to wet iron- and nickel-base alloys. Manganese further improves the wetting. These alloys do not penetrate or dissolve the base metal to any extent. Joints of these alloys have been reported to be less susceptible to crevice corrosion attack than those made with silver-manganese alloys. Their resistance to oxidation is like that of other silver-base alloys.

Manganese-Nickel: Manganese-nickel (70-30 percent) is being used very successfully for joining stainless steel, inconel and other heat-resistant alloys. At elevated temperature it retains much of its high joint strength (55,000-65,000 psi at room temperature), and it offers better oxidation resistance than either silver-copper-lithium or silver-manganese. Its properties fall midway between the latter two fillers and the nickel-chromium-silicon-boron filler metals. That is, in oxidation resistance, it is better than the high-silver fillers, but not as good as the Ni-Cr-Si-B group. On the other hand, it has much less tendency to dissolve or penetrate the base metal (highly undesirable with thin sections) than do the high-nickel alloys. Preliminary tests with manganese-nickel have yielded excellent results and the material is now being actively considered for brazing heat exchangers, rocket motor parts, clad metals, and turbine blades. It is currently available either in powder or in thin strip.

Nickel-Silicon-Boron and Nickel-Chromium-Silicon-Boron: This group of alloys contains nickel as the main constituent, with silicon and boron as the other alloying elements. In addition, in two of the alloys (including AMS 4775 listed in the table) part of the nickel is replaced with chromium to provide superior oxidation and corrosion resistance. In hardness and strength retention in the 1600-1800 F range, these high-nickel materials are unsurpassed. However, they attack many base metals by intergranular penetration and solution.

Typical applications for this group include: a vane-and-shroud assembly of 4130 chrome-molybdenum steel brazed at 2100 F; a nozzle assembly of Hastelloy-25 and type 304 stainless steel brazed at 2150 F; and a flat, tubular stainless steel heat exchanger brazed at 1925 F.

Gold Alloys: In situations where intergranular penetration of the base metal cannot be tolerated, and where high strength and excellent oxidation resistance are required at temperatures around 1600 F, there is a strong interest in gold alloys. To be sure, the high gold content makes these alloys expensive on a per-ounce basis, but in most cases the value of the assembly and the extreme importance of reliable high-temperature performance outweigh, by far, the cost of the small amount of alloy needed to make the joint. Compared with the high-nickel alloys, the gold alloys have lower hardness, better ductility and less tendency toward intergranular penetration. They can be produced in any variety of wrought forms, in contrast to nickel-boron-silicon alloys which are available only in powder, sintered powder, or cast forms. In addition they have excellent wetting and flow characteristics.

Here are a few examples that account for some of the current interest in the performance of gold-nickel-chromium fillers: Lap joints between inconel and stainless steel, brazed in a helium atmosphere at 1900 F without flux, were exposed to air at 1600 F for a period of 88 hours with no adverse effect. Photomicrographs of other joints in inconel and stainless-steel assemblies show only slight grain boundary attack in the stainless steel, but the extent was negligible considering the long brazing cycle employed. Nor was there any intergranular penetration in the inconel part of the assembly. Still other joints, brazed in stainless steel with the gold-chromium-nickel filler and heated in air for seven days at 1600 F, retained a tensile strength of 20,000 psi when tested at 1600 F. This is considered excellent performance at this temperature. Some of the advanced applications for which these gold filler metals are being considered include components for rocket motors, missiles and nuclear reactors.

Filler Metals for Brazing Heat-Resistant Alloys

Alloy Type	Composition (percent) Ag	Au	Pd	Cr	Mn	Cu	Ni	Li	Si	B	Melt (deg F)	Flow (deg F)
Silver-Copper-Lithium	92.3	—	—	—	—	7.5	—	0.2	—	—	1435	1635
Silver-Palladium	90.0	—	10.0	—	—	—	—	—	—	—	1835	1950
Manganese-Nickel	—	—	—	—	70.0	—	30.0	—	—	—	1840	1875
Nickel-Chromium-Silicon-Boron*	—	—	—	16.0	—	—	72.5	—	5.0	3.5	1825	1840
Gold-Chromium-Nickel	—	72.0	—	6.0	—	—	22.0	—	—	—	1785	1835

*Balance Fe

George A. Goodwin
President, 1958-59
The American Society of Tool Engineers

aste
NEWS

George A. Goodwin

In the formal ballroom setting above, Harold E. Collins performs his final act as president in presenting the president's pin to George A. Goodwin. Attaining the highest Society office culminates a twenty year membership for Mr. Goodwin, who has been a tool engineer by profession since 1910.

George A. Goodwin, works manager of the Master Electric Company, Dayton, Ohio, a division of Reliance Electric Company, officially took his place at the head of the 39,000-member American Society of Tool Engineers at their Annual Installation Banquet held May 7 at the Sheraton Hotel in Philadelphia.

Also elected by the Society's directors at a meeting just preceding the banquet, and installed along with Mr. Goodwin by retiring president Harold E. Collins, were: Wayne Ewing, first vice president; H. Dale Long, second vice president; William Moreland, third vice president; David A. Schrom, fourth vice president; Philip Marsilius, treasurer; and Charles Smillie, secretary.

That same morning, in a room across the hall from the directors' meeting, the House of Delegates, whose votes voice the opinions of chapters across the continent, selected fourteen men to sit with ASTE's board of directors for a one-year term starting with the semi-annual meeting in the fall of '58. Results of the balloting, carried on by means of voting machines behind locked doors, showed the following men as "the people's choice":

New Directors-Elect

David A. Schrom	York, Pa.
Cecil Chapman	East Chicago, Ind.
Francis J. Sehn	Detroit, Mich.
Bruce Fairgrieve	Toronto, Ont.
Wilfred J. Pender	Pawtucket, R. I.

Re-elected Board Members

H. Dale Long	Chicago, Ill.
Joseph L. Petz	Poughkeepsie, N. Y.
George A. Goodwin	Dayton, Ohio
Leslie C. Seager	Salt Lake City, Utah
Irving H. Buck	Dallas, Texas
Wayne Ewing	Los Angeles, Calif.
G. Ben Berlien	Oakland, Calif.
Philip Marsilius	Bridgeport, Conn.
Frank F. Ford	Atlanta, Ga.

The fifteenth member of the board, as designated by constitutional directive, will be Harold E. Collins, immediate past president.

Delegates and alternates, once the task of picking the new board was completed, turned to other matters, among them, the question of present percentage allocations of monies to chapters. Group discussion disclosed that no chapter was in such difficult straits as to warrant an increase in its financial allotment to insure a sound operating base. Further clarification of the present schedule of disbursements was made by Treasurer John X. Ryneska, who explained the necessity of maintaining a sizeable cash reserve to cover any emergency situation in which the national organization would have to meet previously-made committments in the face of an unexpected loss of revenue, as, for example, would arise from a tool show cancellation or a decrease in advertising earnings of THE TOOL ENGINEER.

takes office

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The House of Delegates also moved to ask the board for their consideration of the formation of regions or geographical zones within which chapters could pool their operating know-how and combine their efforts in projects mutually beneficial to all members in the area. The matter will be taken up at the semi-annual meeting of directors scheduled concurrently with the West Coast Tool Show in September.

While the delegates focused their attention on these matters, the current directors reviewed the annual reports of the national committees and acted upon recommendations on these reports made by the national officers.

Twenty-Year Vision Sought

Harry E. Conrad, in the executive secretary's report, urged directors to look to the future, develop the Society's principles and philosophy, and formulate a *long-range plan*, encompassing the agreed-on goals and objectives. Such a plan would serve as a target point toward which national committees could set their sights and work for, by means of their individual five-year plans. These common goals, he pointed out, would have greater likelihood of fulfillment with the unified efforts and planning of all segments of the Society working together, and he suggested a special board meeting to look twenty years ahead in Society planning to establish these goals.

Mr. Conrad also emphasized the importance of the educational contribution ASTE is capable of making in the space age. With the resulting stress being placed on more generalized engineering science in America's educational institutions, there will soon be a crying need for specialized technicians to step in and do the specific industrial jobs at hand. With but a small percentage of the nation's manufacturers capable, through size and capital, of offering specialized training courses to engineering graduates, ASTE might well consider ways and means of developing a scientific and technological training center to fill this threatened void.

Among recommendations to which the directors gave their official nod were: acceptance of a newly

President Goodwin opens the book on another year with ASTE, flanked by his first and second vice presidents, Wayne Ewing, left, and Dale Long. Backing him up are Treasurer Marsilius, third and fourth v.p.'s, Moreland and Schrom, and Secretary Smillie.

Representatives from some of ASTE's newest chapters await the call to order of the House of Delegates. From left are: Wilbur D. Russel, San Francisco; Arthur Dzigorski, Sacramento; Salvatore Gianino, North Shore; and Justus Alexander, Mississippi.

designed membership certificate; approval to redesign the Eli Whitney Memorial plaque; acceptance of one design for the proposed public relations display boards, a dozen of which are to be made up and circulated for short periods among chapters requesting them; and the approval for the technical publications committee to start planning for a new book on "Numerical Control of Machine Tools." The O.K. stamp was put on charter applications for three new chapters, two senior chapters in Fort Lauderdale, Fla., and Harrisburg, Pa., and a student group at Erie County Technical Institute.

An informal polling of the board members on the value of the leadership conference brought forth enthusiastic accolades, which echoed the concensus of opinion of the delegates who had attended the two-day program Monday and Tuesday.

Chapter Award Winners Named

A 1958 "first," the announcement of the chapter level awards of merit recipients, occurred at the Installation Banquet. President Collins read the names of the eight men chosen by the national honor awards committee as having made outstanding contributions within the frame of chapter activity: Andrew B. Clark, Cleveland; Thomas C. Barber, Chicago; Willis J. Potthoff, St. Louis; W. J. Frederick, Cincinnati; Jay N. Edmondson, Columbus; Harold D. Hiatt, Indianapolis; Fred J. Dawless, New Haven; and W. A. Dawson, Hamilton.

Whimsy Caps Banquet Climax

Adding a light touch to the more serious events and decisions of the day, the banquet speaker, William Hazlett Upson, noted author-humorist of Saturday Evening Post fame, set out to and succeeded in tickling the funny bones of his audience with his whimsical talk on "Ergophobia" or "morbid fear of work." His unstinting search for a job involving the least work and the highest pay led him to his present enviable position in the world of wit, and the grins on the faces of the banqueteers attested to the success of his calling, as they left the Grand Ballroom of the Sheraton after a history-making day in the 1958 diary of ASTE.

Ira Montague, Ann Arbor Area delegate, briefs Sinclair Hayes of Ottawa Valley on voting booth operation while alternates Alf Peterson from Fort Wayne and Willard Lang from San Antonio listen in. Next year, as delegates, they too will vote.

Philadelphia Day

THE Honorable Richardson Dilworth, above, mayor of Philadelphia, ASTE's 1958 convention city, welcomed Society members and Tool Show exhibitors and attendees to his "town" at the kickoff Philadelphia Day Luncheon May 1.

Harold E. Collins, ASTE president, shown at right checking over the week's schedule of events with keynote speaker, H. Thomas Hallowell, Jr., officiated as a one-man welcoming committee for the Society, while Toastmaster Ed Wheeler, host committee chairman, handled the introductions. The text of Mr. Hallowell's speech starts on page 71.

Thus began a week of machine tool displays, plant tours, technical sessions, women's activities and such usual annual events as the delegates' meetings, election and installation of officers, directors' meetings, and banquets, to say nothing of a Career Day and a Leadership Conference.

Show Theme Embraces Society Aims

The thousands of tool engineers, manufacturing executives and technicians who visited the ASTE Tool Exposition in Philadelphia last month have returned home to conquer their problems with a fund of knowledge acquired in the exhibits, seminars and technical sessions.

The educational value of these conventions cannot always be measured by immediate results. Much of the knowledge gained is stored away for future use.

Most important is the fact that everyone has gained something from it. The individual has gained knowledge, which he in turn passes on to industry. The exhibitors have gained prestige and good will through their contacts with those who influence the methods and equipment used in manufacturing industries. Tremendous satisfaction is brought to the Society members and staff who are back of it.

Whatever was achieved is in retrospect the purpose of the Society as stated in the Constitution; that is, "to promote the advancement of scientific knowledge in the field of tool engineering and through its members engage in research, writing, publication and dissemination of such knowledge."

"Tooling for Competition" was all of this.

Your incumbent administration and staff are dedicated to these aims which establish a never ending goal. May our progress be as notable as our predecessors'.

G. A. Goodwin
PRESIDENT
American Society of Tool Engineers

full house at Tool Show

MANY exhibitors at the ASTE Tool Show, enthusiastic about the businesslike curiosity of the visitors, turned sunny faces toward California as the Philadelphia exposition ended its seven-day stand.

As one of them put it, pardonably rubbing his hands together, "If crowds like this come out in the Philadelphia rain, what won't they do in the Los Angeles sun!"

It rained for six of the show days. But the total registered attendance—32,338—still broke the show record for Philadelphia. So did the number of exhibits—528—and their total estimated value— $12 million.

Tool Show Manager Leonard Abrams reported a flurry of bookings for the West Coast Tool Show, scheduled Sept. 29-Oct. 3 in Los Angeles' Shrine Exposition Hall, as the mammoth eastern affair decamped. Already 150 exhibitors have reserved space for the ASTE's fall show.

Plan Show in New York

Despite the gloomy weather, and the preceding months of economic clouds, the consensus among manufacturing men was that the show was a very good one indeed and, like all good shows, must go on. Plans were already being laid, therefore, by both the participants and the sponsors, for not only the upcoming 1958 date but for the 1960 spring show in Detroit and the 1960 fall show in Los Angeles.

Miss Tool Engineer, Peggy Pickford of Philadelphia, wins the approval of H. Thomas Hallowell, Jr., keynote speaker at the Philadelphia Day luncheon, and retiring ASTE President H. E. Collins for helping get the Tool Show off to a beautiful start. Mr. Hallowell is president of Standard Pressed Steel Co.

In addition, the Society's Board of Directors at their Annual Meeting endorsed the Tool Show committee's recommendation that the 1961 exposition be held in New York City's new Coliseum, provided that certain technical problems be resolved. Principal concern is whether the Coliseum will bear the floor load, which sometimes approaches 600 pounds per square foot for such a show. Tool Show planners feel, however, that heavy exhibits could be booked for the ground floor, which is considered adequately sturdy. Definite decision and date-setting are expected within the near future.

In Philadelphia's Convention Hall, however, the emphasis during the first days of May was on the here and now and how. Machines and models vied for the attention of the crowds, and, more often than one might expect, the machines won. For the theme of the show was "Tooling for Competition," and the temper of the people was just that.

Indicative of the ASTE exposition's popularity and importance, as the nation's most elaborate showcase of mass production machines and ideas, are these representative remarks from exhibitors:

"Responsive buying mood."—Neil B. Michie, vice president, AA Industries, Inc.

"Higher quality attendance than ever before."—Charles K. Kaiser, general sales manager, Lapeer Mfg. Co.

"Successful for my operation beyond all expectations. I predict sales will zoom and distributorships will be expanded as a direct result of contacts made at the show. And I'm looking forward to Los Angeles."—C. A. (Jarv) Jarvis, general manager, Sierra Machine Co.

High Caliber Visitors

"The best ever, and I've been associated with the ASTE shows for 15 years. We're getting the cream of the small shop crowd—the higher echelon of buyers. They're not just literature collectors."—Albert R. Dorn, Accurate Bushing Co.

"Very high caliber of registered visitors."—Rudolph W. Andreasson, Jr., Detroit Reamer and Tool Co.

"Higher quality attendance. Fewer sightseers."—Bob Bach, advertising manager, N. A. Woodworth Co.

Perhaps one of the most authoritative and objective assessments of the 1958 show came from a West German manufacturer, spokesman for a group of five European business executives touring this coun-

Posted prices indicate show was cost-conscious. In picture at right, a "sold" sign on $13,500 machine furnishes a comforting backdrop for exhibitor A. L. Klingelhofer as he talks with Canadian ASTE members, J. G. Scherer in foreground and A. C. Stewart, both of Galt, Ont. (Grand River Valley chapter).

try for information and ideas on technical management. The manufacturer, Friedrich Richart, head of a steel construction firm in Hamelin, said:

"Excellent in light and medium-heavy equipment."

He and others in his party took particular note of the number and scope of foreign exhibits, and observed that many of the exhibitors were solving the problems inherent in import equipment—customs, shipping, insurance, testing and inspection, headaches of language and communication, finance, servicing and spare parts.

Tending to substantiate such an observation was one foreign tool maker's report of nearly $350,000 worth of sales during the first five days of the show.

While an air of high seriousness was perhaps dominant, there were diversionary aspects present too. There were beautiful models here and there—a mermaid, a sloe-eyed Miss Coolie Toolie, a redhead, coeds in the caps and gowns of a "college of cylinder knowledge."

Perhaps the most endearing spot of all was the ASTE Center with its chairs and sofas scattered about—and nearly always full of walk-weary people.

There were floating lamps, a puppet show, a giant press gently cracking English walnuts, a goldfish bowl, machines spewing out nameplates and lucky pennies. People flocked to see the industrial diamond booth, with its million-dollar exhibit of run-of-the-mine stones grouped into categories of quality and application, and the Vanguard rocket's nose cone, a shining example of parts finished with diamond tools. They watched a unique numerical control system for automating machine tool cutting functions in three dimensions. They saw an electronic hole checker that measures bores for size and taper down to .043 (size of a typewritten period). They observed a new gage head with a featherlike tip pressure of five grams (one-sixth of an ounce) checking small, thin parts without distortion.

And many of the visitors picked up playing cards and a chance to win $125 in free drills at one booth. They wore the cards in their pockets, with the accompanying instruction: "Stop me if your card and mine makes any poker hand."

Few hands will beat a full house.

Quotes and Misquotes About the Tool Show

From an ASTE member:
". . . Makes me proud to have been a member for so many years! Took my boss—he was impressed!"

From 527 exhibitors:
"Excellent attendance and very good quality . . ."

From one exhibitor:
". . . . ! . . . ."

From a woman visitor:
"I need new heels."

From a Philadelphian, on the Friday morning after the show closed:
"Is this Sunday?"

LEADERS in the making

Man behind the scenes in planning the Leadership Conference was Allan Ray Putnam, assistant executive secretary of the ASTE, who finally took the spotlight at the conference as narrator for the play, "Sauce for the Gander." On the heels of a busy two weeks in Philadelphia, Mr. Putnam was elected president of the Council of Engineering Society Secretaries, meeting in Cleveland May 13-14. During the past year he served as vice president of the council, which represents 650,000 engineers and scientists throughout the nation.

SEVERAL hundred members of the top echelon of the American Society of Tool Engineers devoted two packed days during the 1958 Annual Meeting to the premise that leaders are made, not born.

The leadership conference, revived this year on an annual basis after a successful pilot performance back in 1953, was perhaps the most ambitious undertaking on the Philadelphia agenda. And the consensus—among the "faculty" drawn from the national family and headquarters staff, and among the "students" themselves—was that it was the most rewarding activity of the crowded week.

The Board of Directors, polled at their meeting two days after the conference closed, were unanimous in their approval of the conference's aims and in their praise of its effectiveness.

One of the "students," who consisted of the newly elected chapter chairmen (delegates), plus the faculty advisers of student chapters and optionally the new chapter first vice chairman (alternates), ventured that the conference would lead to a "renaissance" in the ASTE.

Another said simply, "I learned a lot. And it came easy, too."

The concentrated short course in the art of leadership came easy for the conferees because the doses were informalized and dramatized through the use of off-the-cuff talks, dialogues and playlets staged by faculty and professional actors, visual aids and workshop tables.

The purpose of the conference, simply stated, was to impress upon the chapter chairman the magnitude of his new job.

A first-day series of vignettes and "gallery of portraits" schooled him in the history, objectives, and personalities of the ASTE; acquainted him with national policies and operations; provided insight into chapter operations; and attempted to inculcate sound principles of chapter helmsmanship.

On the final day the conferees were split into groups and rotated among six "conference tables" covering various Society activities. This workshop day, in the opinion of many participants, was the most beneficial part of the program.

Leadership conferees watch "Gallery of Portraits" during first day of two-day meeting in Philadelphia's Sheraton Hotel.

Vice President Dale Long speaks to one of six groups of chairmen-delegates who visited the conference table on education during second day of meeting. Conferees were divided into maneuverable groupings who moved from one to another of six workshop tables during day.

Stopped by the cameraman on their way to a Leadership Conference session were (front, left to right) Garland J. Shepherd, Little Rock chapter; E. A. Lindwall, Niagara District; William J. Levy, Jackson; (back row) ASTE Vice President William Moreland: Bernard Wallis, Detroit; Richard G. Shaw and Alfred E. Peterson, Fort Wayne.

Career Day in Capsule

Fourteen hundred sixty-three students converged on Convention Hall Thursday, May 8, at the invitation of the national education committee, to participate in a Career Day program. The agenda combined talks on the role of tool engineers in industry, and tours of the Tool Show.

Robert E. McKee, training director for R. K. LeBlond Machine Tool Co., and Past President Harry B. Osborn, Jr., technical director of Ohio Crankshaft, addressed the high school student group, while Dr. A. R. Spalding, Purdue, and Harold N. Bogart, Ford Motor Co., spoke to a large audience of students at the college level.

Art Gould, center, chairman of the education committee, chats with Dr. A. R. Spalding, speaker from Purdue. Gilbert Seeley, ASTE education director, looks over program notes. Right, graduate engineers from India, studying at Lehigh University, smile approval of the automatic ball bearing inspecting device. From left are P. C. Goyal, A. K. Biswas, R. K. Jain, S. Govindaswamy, I. A. Dasan, and demonstrator Dick Gordman, Sheffield Corp.

Executive Secretary Harry E. Conrad of ASTE chats with guests after banquet. Left to right are George S. Eaton, executive secretary of NTDMA; Ludlow King, executive vice president of NMTBA; Mr. Conrad; Philip Marsilius, NTDMA president and an ASTE director; and Lester Bellamy, ASTE past president.

One of the most popular havens for footsore visitors to the Tool Show was the ASTE Center with its array of comfortable chairs and reading material. Pointing to display in center is Phil Harvey of headquarters staff.

These six gentlemen spent Saturday night at the Convention talking about metal-cutting research. Chairmanned by Francis W. Boulger, right, of Battelle Memorial Institute, the special registration seminar featured five-minute talks by panel members and a discussion period with a traveling microphone. Left to right are Prof. K. J. Trigger, University of Illinois; Norman Zlatin, Metcut Research Associates; R. E. McKee of R. K. LeBlond Machine Tool Co.; E. L. Fowler, International Nickel Co.; and Prof. L. V. Colwell, University of Michigan.

The SIP universal measuring machine, which measures to an accuracy of from one hundred thousandths to ten millionths of an inch, drew the attention of visitors at the Standard Pressed Steel plant tour. G. K. Stopps peers through the eyepiece while Frank Rice, Stan Bojeski, and L. A. Farrington await their turn at the European machine.

Happy Society Secretary Charles Smillie precedes Director Leslie Seager and Frederick Preator of the education committee down the Sheraton's famed "floating" stairway backed by an exotic sculptured metal screen.

Posed and Unposed

Head ladies responsible for the women's activities program were Mrs. William Griffith, Mrs. Paul Raguse, and Mrs. Robert Griffith. Feminine convention fare included tours to historic sites in Philadelphia, and to Valley Forge.

Canadian Area breakfast brought out the following well-known faces: C. K. McCaffrey, center front, and thence clockwise, "Rip" Collins; L. G. Singer, Toronto director; William A. Thomas, Windsor; R. E. Crawford, Director-elect Bruce Fairgrieve and R. A. Wakefield, all of Toronto; Past President R. B. Douglas, Montreal.


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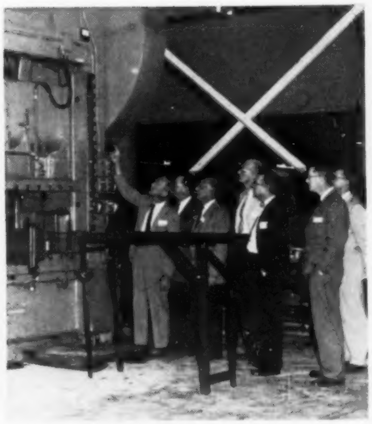


Convention photographers (at left) looked high and low for the right pictures. Some of their results are (reading left to right, top to bottom): ASTE wives get acquainted at continental breakfast. . . . Group on tour of Standard Pressed Steel Co. plant, Jenkintown, view 300-ton press. . . . Retiring President H. E. Collins hands Eli Whitney Memorial Award to Harold N. Bogart, Ford Motor Co. staff, who accepted plaque on behalf of the winner, ailing Ford Vice President D. J. Davis. . . . Convention Hall strollers are Mr. Collins, Chairman Ed Wheeler of Philadelphia host committee, and Vice President Wayne Ewing. . . . Banquet couple is Mr. and Mrs. Cecil Chapman; he's a new member of the Board of Directors. . . . Lei Ming, Philadelphia model, was a Tool Show drawing card in her role as "Miss Coolie Toolie". . . . One of six national honor award winners, Jesse Daughertv, receives Engineering Citation from Mr. Collins at Honor Awards Dinner. . . . Surrounding new ASTE President George A. Goodwin after banquet are Mrs. Maudie Collins, Mrs. George Leckrone, and Mrs. Goodwin.

Convention Candids

Gathered around a Chrysler Corp. missile display at Philadelphia's Franklin Institute are participants in the guided missile program of the Convention's technical sessions. Right to left are Dr. I. M. Levitt, director of the Fels Planetarium at the institute; Emil A. H. Hellebrand of the Army Ballistic Missile Agency; F. R. Swaney, superintendent of Chrysler missile operations; Karl G. Nowak of Fenwal, Inc., Boston, vice chairman of the ASTE national program committee; and Robert W. Cuthill, chief engineer of the Army Ordnance Missile Command, Huntsville, Ala., who chairmanned the program.

Report on Convention MISSILES Session

SPEAKERS at the guided missile session of the ASTE Convention posed two challenges to tool engineers: how to bridge the gap between the drawing board and the launching pad so as to keep abreast in the missile race; and how to achieve the extreme reliability so mandatory in missile production.

In an interview preceding the technical program, Robert W. Cuthill, chief engineer of the Army Ordnance Missile Command (AOMC), indicated that the problems of design, product engineering, procurement and production, supply, distribution and maintenance were being more readily solved under the recently revamped Army chain of command. The AOMC is under Mr. Cuthill's immediate superior, Maj. Gen. John B. Medaris, the officer who directed a team of technicians and scientists to the successful completion of the Jupiter IRBM and placed the first U.S. satellite Explorer in orbit.

The over-all command, superposing the Army Ballistic Missile Agency, will be able to call on all U.S. Ordnance Corps resources, including other commands, arsenals, proving grounds, laboratories, depots and districts, for support in their specialized fields, Mr. Cuthill said. Subordinate agencies under the AOMC are the Army Rocket and Guided Missile Agency (formerly Redstone Arsenal at Huntsville, Ala.), the Jet Propulsion Laboratory at California Institute of Technology, the Army Ballistic Missile Agency, and the White Sands Proving Ground.

Mr. Cuthill, a native Philadelphian who has been in ordnance work since 1938 and in missile development since its inception in 1948, was chairman of the two-paper session on missiles held at the Franklin Institute in Philadelphia.

The lectures followed a unique "Trip to the Moon" presentation by Dr. I. M. Levitt, planetarium director, featuring music, blast-off sound effects, a blue-black universe on the ceiling, an out of this world style show, and all the amenities of imaginary travel in the space ship of the Interplanetary Transit System, Inc.

F. R. Swaney, general superintendent of experimental production, Chrysler Corp. missile operations, talked on "A Production Engineer Looks at Missile Design." With Chrysler for 17 years and an original member of the team that worked on the Redstone and the Jupiter C, Mr. Swaney urged the importance of meshed planning in missile production. Parallelism, rather than step-by-step accomplishment of the various tasks connected with missile production, is the key to success, he said.

"The knowledge and experience of the whole missile effort—design, product engineering, procurement, testing—must be fed back and forth constantly and efficiently," he asserted.

Burden on Tool Engineer

Mr. Swaney and Emil A. H. Hellebrand, aeronautical research engineer with the Ballistic Missile Agency, who followed with a paper on "A Missile Designer Looks at Production," both stressed that the burden of the missile age rests firmly on the tool engineer.

It is the tool engineer who must meet the challenge and bear the grave responsibility of building extreme reliability into the 20th century's most advanced symbol of technological complexity, they indicated. It is the tool engineer who must "make the target area more dangerous than the launching area."

Conferees learned that ground support equipment is often more complex than the missile itself or its payload.

highlights from the technical sessions

by T. W. Black, senior associate editor

From the standpoints of quality and coverage, the technical sessions of the ASTE 26th Annual Meeting were outstanding. The topics ranged from such basic fields as metal-cutting to the more exotic field of nuclear engineering. Each speaker was an outstanding authority and each contributed significantly to the over-all success of a program dedicated to the theme "Tooling for Competition."

This review is intended to illustrate, in concise form, the content and scope of the complete papers.

Aircraft Production

The production of aircraft and missiles has passed the automotive industry as the largest industry in the United States in terms of dollar volume. Unlike automobile production, much aircraft production is on a short-run or custom production basis. This calls for creative tool engineering of a high order, and many of the techniques that have been developed for aircraft manufacture can also be applied to similar production.

In Paper 46, for instance, **Karl L. Melde** discusses the use of magnesium in aircraft tooling. The light weight and machinability of magnesium have made it indispensable for some jig and fixture applications. Overhanging jig parts welded from magnesium tooling plate provide precise location without imposing undue loads on the basic structure. Bench type fixtures of magnesium can be easily handled by one man. Magnesium form dies are almost self-lubricating when shaping aluminum and the high machinability cuts fabrication costs.

Advanced aircraft designs demand new manufacturing and production techniques. As pointed out by **Ralph A. Fuhrer** in Paper 47, there are three major innovations that have changed airframe manufacture: the weapons system concept, in which the manufacturer is given complete responsibility for an aircraft envelope or end-item package; sustained heating characteristics of the aircraft; and high-frequency vibration characteristics. At Convair, tool engineers work closely with product designers while the basic structure of the airframe is being established. The B-58 airframe has four different types of structures. Tool engineers select the most logical manufacturing method for each type of structure prior to the time of product design release. This makes it possible to start tool design early.

Weight reduction in aircraft manufacture makes it possible to increase the payload. According to **Arthur A. Merry** and **John G. Campbell,** Paper 51, a commercial airplane with four engines having certain parts made of titanium is 820 pounds lighter than an airplane in which conventional engine materials are used. This makes it possible to carry additional passengers.

Unfortunately, forming complex shapes from titanium may present problems. One answer is the use of power roll-forming, Floturning or Hydrospinning techniques. Convair tool engineers have had excellent results in forming parts from machined, extruded and even welded blanks. An extremely interesting development, described by Merry and Campbell, is power roll-forming centrifugally cast stainless steel shapes. During the forming operation, the characteristics of the material are changed from a cast structure to a wrought structure.

The concept of systems engineering, originally developed in connection with aircraft weapons systems and the like, includes the idea that men are part of the system. **Max A. Pape, Richard W. Faubion,** and **Nikki Kaye** point out that safety engineering is part of human engineering. It is the safety engineer's mission to effect a decrease in accidents, using whatever methods are necessary. He must accept the concept of man-machine relationships or systems. Accident prevention should start with machine design.

Plastic Tooling

Some of the advantages of plastic dies are low cost, light weight, and reduced tooling time. As pointed out by **A. P. Mazzucchelli,** Paper 55, heat-resistant epoxy resins with metal or glass fiber reinforcements are superior die materials. They extend the range of plastic dies, usually restricted to low-production applications, to medium-production work. Abrasion resistance, impact strength, heat-distortion point and thermal conductivity are much greater than those of conventionally filled room-temperature epoxy composi-

highlights from the technical sessions

tions. These new materials have been successfully used for radiator tank top dies, refrigerator panel forming dies, matched mold and foundry patterns, and similar items.

Production experience in the use of plastics for making duplicate die models, engineering checking fixtures and prototype tools is described by **J. T. O'Reilly** and **H. L. Wyatt,** Paper 56.

Shell molding, another application of plastics to tooling, is probably the greatest cost-cutting contribution to the metal-cutting industry since the advent of cemented carbide tools. As a precision preforming process, says **Otto W. Winter,** Paper 57, shell molding can substantially reduce the amount of chips cut in the United States. It is estimated that some 15 million tons of chips are generated annually in this country. Mr. Winter's comprehensive paper covers the shell molding process, its advantages and detailed information on tooling and molding practice.

Steel Forgings and Extrusions

The general advance in metallurgical knowledge over the years has contributed to a steady improvement in forging techniques which has resulted in greater reliability. Today, jet engine rotors, steam turbine rotors, and numerous components for nuclear power systems are produced as steel forgings. Types of forging equipment and a general review of the forging industry itself are included in Paper 63 by **A. O. Schaeffer.**

Close dimensional accuracy is obtained by following hot extrusion with cold drawing. This practice has been found particularly advantageous in the production of small sections to be used in the manufacture of parts for business machines, jet engines, electrical equipment, agricultural machinery, machine tool components, air-frame sections, and the like. Many parts now being made as castings, forgings, or machined from solid stock can be replaced by hot-extruded, cold-drawn sections at a considerable saving in cost. **R. L. Hugo** describes the process, part design considerations, and tooling in Paper 62.

Nuclear Engineering

Standardization is a means of cost reduction through conservation of manpower and materials. As pointed out by **Henry H. Hausner,** Paper 64, the cost of today's nuclear power reactors is still so extremely high and the power produced is so expensive that nuclear power is not yet economical in this country. Standardization, as a means of cost reduction, is badly needed. Areas for standardization include nomenclature and definitions, safety precautions, and materials and components.

Prior to the atom bomb program, uranium, zirconium, and hafnium were simply metallurgical curiosities. Today, according to **H. C. Amtsberg,** Paper 65, these exotic materials must be produced in relatively large quantities and properly fabricated. The difficulties involved in fabricating "hot" materials are obvious. Even the nonfissionable materials (zirconium and hafnium) require exceptional handling procedures. They are nonmagnetic and highly reactive with atmospheric nitrogen and oxygen. Both zirconium and uranium are pyrophoric in finely divided form, such as machine chips. These factors, combined with odd shapes and close tolerances, demand unusual tooling fixturing methods, plus high standards of workmanship, housekeeping, and maintenance of tools and equipment.

Cutting Tools

In many tool steel applications, toughness is among the most important properties. In Paper 66, **Gary Steven, A. E. Nehrenberg** and **V. D. Chandhok** report on a new method for making toughness measurements. Their method makes it possible to rate the toughness of the various families of tool steels as well as to distinguish between different heat treatments of the same steel. Unlike conventional methods, the new technique is not restricted to room-temperature testing. Tests can be made at any temperature range encountered in service.

In the past 20 years, the carbide cutting tool has evolved from a novelty which was kept locked in the safe to its present universal application. Historical developments are covered in Paper 67, by **W. L. Kennicott.** Mr. Kennicott also indicates present trends that will result in improved efficiency. Use of high-modulus carbides in toolholders and in the tool blocks of metal-cutting machines is already in experimental use. With the greater support and improved rigidity thus possible, harder cutting compositions may soon be used with resultant greater metal removal rates. This illustrates the fact that mechanical and metallurgical improvements are interdependent.

Ceramic Tools

Cemented oxide (ceramic) cutting tools, like carbide tools, are undergoing rapid evolution. In this era of mechanization and automation, every function of a machine tool must be speeded up, including cutting speeds. Short tool life, as pointed out by **Wallace B. Kennedy** in Paper 69, is the basic obstacle to increasing machining speeds. Ceramic cutting tools provide a solution to this problem. Further, high-velocity machining reduces heating of the tool. Since it is known that metals rapidly lose strength at elevated temperatures,

Papers Available from Headquarters

Recognizing the permanent value of the technical papers presented at the Philadelphia Convention, the ASTE program committee has made them available in printed form.

Copies can be obtained from Society Headquarters, 10700 Puritan Avenue, Detroit 38, Mich. Cost of individual papers to ASTE members is fifty cents each; to nonmembers, $1. Collected papers run $5 for members, $10 for nonmembers. Papers of the Metal Cutting Review Seminar, the Powdered Metal Parts Symposium, and the Numerical Control Symposium are priced at $3 per set for members, $6 for nonmembers.

there is reason to believe that the workpiece surface is in a highly plastic stage at the moment of contact with the tool and the heat dissipated almost entirely into the chip. The fact that grain distortion is considerably reduced in the high-velocity range (above 1000 fpm) seems to justify this theory. Many other test results with high-velocity machining are described by Mr. Kennedy.

Characteristics and experimental performance of certain new ceramic tool compositions are covered in Paper 69 by **A. G. Klug** and **W. M. Wheildon.**

Tool Engineering Research

A common problem of tool engineers—how to offer the best product under competitive conditions without sacrificing quality—is illustrated by **Richard S. Hildreth** in Paper 70. This problem can best be approached through research. A good example of successful research is the development of methods for cold rolling of splines. Another example, also described by Mr. Hildreth, is the development of a shaving machine capable of accommodating gears 180 inches in diameter. The supporting table rotates within 0.0003 inch of concentricity and within 0.0003 inch in the flat plane of rotation.

Development work described by **O. H. Nuss** in Paper 71 has shown that it is possible to saw aluminum alloys at the speeds conventionally used for sawing wood. The tests were conducted with saws having 12 to 16-inch diameter blades revolving at a nominal 3600 rpm, giving cutting velocities of 10,000 to 15,000 fpm. Solid 3.5-inch thick plates have been cut with a surface finish of 12 microinches and parallelism of 0.0015 inch. Successful high-velocity cutting has been made possible by a precisely controlled air-hydraulic power cross feed, application of coolant by an atomized-mist device, use of carbide-tipped saw blades, and understanding of the basic interrelationships of cutting variables.

In a talk on some relationships in the theory of metal-cutting, Paper 86, **Max Kronenberg** suggests a cutting formula that takes into account the dynamics of chip flow. Ordinarily, in deriving equations for the cutting force and shear angle based on stress analysis, the chip is considered as a stationary body in static equilibrium. This makes it impossible to take chip flow and compression into account.

Machine tool dynamometers are devices for measuring the force or forces between the tool and the work during cutting operations. They are fundamental tools for metal-cutting research. In Paper 87, **Erik K. Henriksen** explains the design characteristics of production type dynamometers and describes how a dynamometer is used for tool life and similar studies.

Metal-Cutting Review Seminar

In a separate seminar, a number of papers were devoted to a comprehensive review of available basic information on metal-cutting. The economic importance of chip making was pointed out by **Hans Ernst,** Paper 43. The wages and overhead costs of the million or more operators of metal-cutting machines and tool-sharpening machines must be charged to chip making. To this must be added the cost of the metal removed, and the depreciation and maintenance of the machines. Better application of known methods could save a substantial portion of these costs.

What is known today about metal-cutting is covered in Paper 44, a comprehensive summary by **Francis W. Boulger.** Tool life, productivity, chip formation, cutting temperatures, cutting fluids, surface finishes, and experimental procedures are the major topics. Mr. Boulger's work shows that the influence of tool and cut geometry, cutting speed, and workpiece microstructure on surface finish is reasonably well established, as are the mechanisms by which cutting fluids function. Many of the available testing methods are satisfactory for investigations directed toward improving cutting fluids, tool materials, or workpiece materials. In the future, however, greater attention should be given to reporting investigations thoroughly enough so that the cause of scatter in experimental observations can be assigned to the proper variable. The mechanics of metal-cutting are fairly well understood. Continued effort, using modern experimental techniques, should clarify the controversial points in metal-cutting theory. Then the theories and studies should be extended to the more complicated, commercial operations.

Metal-cutting forces are analyzed by **Prescott A. Smith,** Paper 45. Mr. Smith shows what these forces are, how they are determined, and how cutting force analyses can be used. Often, the first indication of tool wear or approaching tool failure is an increase in cutting forces. At low speeds, workpiece finishes and cutting-fluid effectiveness are directly indicated by cutting forces. At higher speeds, measurement of cutting forces helps in the isolation of the role of cutting fluids. For example, in attempting to determine the cooling ability of cutting fluids, measurement of cutting forces makes it possible to calculate the total energy input. By measuring the tool-chip interface temperature and the temperature on the surface of the work, the energy distribution is known. The metal-cutting research engineer then has quantitative information with which to analyze the problem. Cutting forces are also important in jig, fixture and machine design, and in machine selection.

Cutting tool geometry is explained by **S. W. Lovejoy** in Paper 48. The purpose of front and side clearance and relief angles is to reduce the rubbing of the tool flank on the cut surface, thus reducing friction, which may be a cause of chatter, poor finish, short tool life, deflection, and other undesirable effects. The purpose of the positive side cutting edge angle and the end cutting edge angle is also to prevent rubbing of the cut surface. Back and side rake angles control chip flow and the pressure of the chip against the tool face.

As new and harder cutting materials are developed, refinements of design become more important. Cemented carbides and ceramics perform best under compression rather than tension or shear. This condition can be obtained by designing a negative back rake land on the face of the tool, equal in width to approximately two and one-half times the feed per revolution. The negative angle of this land should be two to three degrees greater than the front clearance angle, thus putting the cutting edge in compression. Negative back rake increases horsepower requirements but improves surface finish. Keeping the design of cutting tools simple permits cutting tool standardiza-

highlights from the technical sessions

tion, with consequent cost savings.

Our knowledge of metal-cutting is not nearly as exact as it could be, according to **David N. Smith**, Paper 49. In metal-cutting research, there is need for a systematic approach to machinability testing. This involves developing generally acceptable testing techniques and methods, and ways of collecting and reporting data so that the exchange and correlation of information is facilitated. Some sort of master plan or over-all framework would be of great help in attacking metal-cutting problems. One way to construct such a frame of reference is to visualize the metal-cutting operation as an input-output process, with all the controllable variables as inputs and all the resulting effects as outputs. Input variables can be grouped as "machine," "process" and "environment." Outputs are "machine wear," "chips," "tool wear" and "product characteristics"

According to **E. L. H. Bastian**, Paper 50, efforts to study and to understand factors involved in utilizing lubricants for improved metal-cutting date back as far as 1851. Progress in research is documented by Mr. Bastian, who then summarizes the present state of knowledge in the field, including functions of fluids in service, mechanism of fluid functions, types of fluids, applications, and fluid maintenance. The treatment of each of these topics is comprehensive.

Tool life is the subject of Paper 53 by **L. V. Colwell.** Satisfactory tool life is, of course, based on many different conditions. The term "satisfactory" may be based simply on the ability to remove metal. In other instances, it is based on such factors as surface finish, size control, rate of cutting, and economics. All tools reach the end of their useful life by either of two mechanisms: they break under load or they wear out. In practice, few tools are allowed to break. For this reason there is increasing interest in the rate of wear of cutting tools. It is practical to base tool life on the amount of wear that is taking place on the tool flank.

In some operations, such as sawing, dead weight or constant hydraulic pressure may be used to overcome feeding force. Any increase in feeding force required as the result of tool wear will result in a reduction of the rate of cutting. In such instances, tool life is based solely upon the rate of cutting. Another way in which tool life is measured is by the failure of the cutting tool to continue to produce a satisfactory surface finish. Whatever the basis for determining tool life, there is a best or optimum tool life for minimum cost, providing tool life is increased as cutting speed is reduced.

Hardness is not, in itself, always an accurate guide to the machinability of a steel or cast iron, as pointed out by **Norman Zlatin**, Paper 54. At a cutting speed of 900 fpm, for instance, the tool life resulting from machining an annealed nodular iron having a hardness of 170 Bhn and an ultimate tensile strength of 70,000 psi is the same as that obtained with a gray iron having a hardness of 100 Bhn and an ultimate tensile strength 15,700 psi. These two cast irons with different physical properties and forms of graphite are equally machinable because their microstructures are similar. It is not uncommon to find a group of medium carbon alloy steel forgings being machined under the same set of cutting conditions. If the cutting speed is selected so that a satisfactory tool life is obtained with forgings having a 75 percent pearlite-25 percent ferrite structure, this same cutting speed will be at least 35 percent too low for similar forgings having a spheroidized structure. This points up the importance of analyzing the microstructure of workpiece materials. Mr. Zlatin gives examples of typical microstructures found in steels and cast irons.

Single-point turning is one of the oldest and most basic machining methods. **Albert B. Albrecht,** Paper 58, stresses the fact that improvements in machine tool design have led to practical cutting speeds far above those possible a few years ago. However, present turning speeds are often about 40 percent lower than those feasible on new equipment. Mr. Albrecht shows how tool engineers can "get the most" out of modern engine lathes.

The ordinary twist drill is an exceptionally rugged tool and often little thought is given to its operation. Yet, this tool involves a complex cutting action and its performance is quite sensitive to its design and operating conditions. The major factors in drilling technology—drill design, calculation of rotational torque and axial feeding thrust, drill life and operation conditions — are given comprehensive treatment by **Carl J. Oxford, Jr.**, Paper 59.

Milling practice today is the subject of a treatise by **A. O. Schmidt** and **J. R. Roubik,** Paper 60. The authors emphasize the trend toward using greater power to achieve faster metal-removal rates and summarize present knowledge of the milling process. Some of the topics are cutting speeds, tool temperatures, automation, tool design, workpiece design and optimum economic cutting speeds.

It is often stated that tool-tip temperatures and the associated rate of tool wear first increase with increased cutting speeds, reach a maximum, and then decrease with still higher cutting speeds. This contention is based on experimental work performed by D. Salomon some 30 years ago. The authors disagree with this theory, feeling that Salomon's was based on inaccurate thermocouple measurements.

Tool grinding—past, present and future—is covered by **Carl Soderlund,** Paper 61. Methods for determining the grindability of various steels are discussed. By making a few tests in the shop, the tool engineer can obtain a good indication of the ease or difficulty to be expected when changing from one steel to another, or when changing any of the pertinent variables.

As harder workpiece materials come into general use, grinding problems are multiplied. Use of diamond wheels may be justified when all factors, such as time and ease of dimensional control are considered. Another possibility is to continue to use the present types of wheels with continuous automatic dressing. In this method, as used for keeping tobacco-cutting knives sharp, a diamond oscillates at a fixed distance from the desired work dimension. The wheel is continuously fed into the diamond at a rate just sufficient to keep the wheel sharp and clean and the work to the exact dimension. An additional improvement might be the use of a rotating diamond cone or diamond wheel for dressing. Additional grinding operations to provide an exceptionally smooth finish may pay off in added tool life.

Four talks made by members of the metal-cutting review seminar panel are published as Paper 72. **D. G. Jones** states the case for a new system of carbide selection known as the "Grade Selection System." The basic factors to be considered are the material to be machined, the type of operation, oper-

ating conditions and tool wear analysis. A grade selection chart is included. **R. E. McKee's** paper deals with the science and application of metal-cutting. He finds that the scientific application of metal-cutting techniques involves the continuous study of the ability of metals to be machined, the ability of cutting tools to separate materials, the ability of machine tools to support machining and the ability of cutting tools to aid in machining.

R. T. Hook showed how machining efficiency can be improved by consideration of human engineering factors, economic cutting speeds and more machinable materials. **W. W. Gilbert** was the fourth panel member.

General Tool Engineering

Many of the technical papers are of wide interest since they deal with overall aspects of tool engineering itself, rather than a narrow field. Static switching is discussed by **Arthur H. Wolfson,** Paper 73. The topic illustrates the broad field of knowledge—including electronics — that must be covered in any general discussion of tool engineering. Automatic machines follow logical sequences and static switches—which have no moving parts and are of the plug-in type—can be installed to control those sequences. Mr. Wolfson does not describe how the switches work, but how they can be used. The logic control circuit for an automatic OD gage is given as a typical example. Many such circuits can be combined to control a fully automatic line.

Ceramic tooling for forming and curing high-temperature plastics are discussed by **J. D. Stillman,** Paper 74, who outlines tested procedures for making this type of tooling. The tools are made of clay and a material normally used for investment casting. Standard pottery techniques are used. Since the completed tools are vitreous after firing, only a light application of grease is required as a parting agent when forming plastic parts.

New manufacturing techniques for making hydraulic servo valves are covered by **Edgar M. Hakanson,** Paper 81. Owing to extreme service requirements, manufacturing tolerances are critical. Rather than attempting to make all components completely interchangeable, valves and spools are produced as matched pairs. Optical methods are used in grinding.

The continued demand for higher metal-cutting speeds has created great interest in cemented oxide (ceramic) cutting tools. These tools can be used at extremely high speeds; however, until recently, there was little information available on the effects of tool geometry, feed and other cutting conditions on tool forces at high speeds. **H. J. Siekmann** describes tests with an ultrahigh speed 150-hp lathe to find some of the answers, Paper 82. Tests were run at speeds up to 18,000 fpm. These tests showed that high-velocity machining is technically feasible and economically sound. This should be an incentive for the development of machine tools capable of utilizing ceramic tools to the fullest extent.

Automatic size control for centerless grinders is the subject of Paper 88 by **Arthur Parnes.** Unlike most automatic control systems, which are usually of the "open-loop" type, the system described by Mr. Parnes is a "closed-loop" type. It incorporates a feedback loop and error detector. A motor and suitable amplifier are installed in place of the conventional feedscrew drive. Thus, the system is entirely self-correcting.

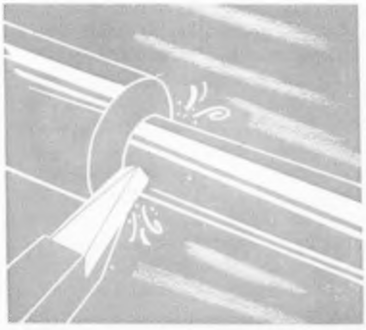
The surface finish produced by electrodischarge machining can be measured with the same equipment used to measure ground surfaces. As pointed out by **Charles H. Good,** Paper 89, there is a significant geometrical difference between the surfaces produced by the two processes. Even when measurements indicate the same surface finish on a ground surface as is indicated on an electrodischarge-machined surface, the latter surface may have superior functional characteristics. An electrodischarge-machined surface, because of its multidirectional lay, has a larger bearing area than an equivalent ground surface. Thus, if a surface is subject to wear or requires dimensional stability of any sort, electrodischarge-machining may be the most satisfactory finishing method.

The fundamentals of gaging screw threads for acceptability are covered in Paper 124 by **Eric G. Gabbey.** He points out that close control of pitch diameter also controls the form variables. Measurement of the pitch diameter at the same point and by the same method enables screw manufacturers and their customers to reach agreement.

In order to design servomechanisms that will operate to best advantage, it is essential to know the actual values of the coefficients of static and kinetic friction of the materials used. Data on the frictional behavior of certain metals and plastics are given in Paper 125 by **A. O. Schmidt** and **Elmer J. Weiter.** The authors found that little frictional data were available for designing sliders on an automatically controlled machine tool mechanism. Discarding conventional point-contact test equipment, they devised a machine for determining frictional values of flat-contact areas. Results of the tests indicate that the coefficient of static friction will vary with the length of time at rest prior to breakaway. Since servocontrolled mechanisms are at rest for variable periods of time, the values obtained are extremely useful. There is also a variation with wear. The effect of time at rest upon the power required to start an actual machine tool component moving on its ways can be computed from data established by the authors.

There is sometimes a question as to whether centrifugal force may cause lathe chuck jaws to loosen their hold on a workpiece. To find out the anwer, a variety of types and sizes of chucks were tested in experiments described by **E. J. Weller,** Paper 128. It was shown that good chucks, properly maintained, are capable of effectively holding workpieces while operating at speeds and feeds dictated by modern production requirements and cutting tools. Frequent inspection of chucks for cracks is a necessary safety precaution.

Advantages of mechanical toolholders are discussed by **Harold E. York** in Paper 129. In Paper 130, **George E. Gault** demonstrates the economic advantages of progressive dies. The die cost for progressive dies is generally higher per station than the cost of individual dies for each station. This is due to timing and coordination of steps, which are not a problem with individual dies. Die set costs, however, may be lower, since only one die set is used. Progressive operation is highly efficient when product volumes are high and, when all factors are taken into



highlights from the technical sessions

consideration, may give lowest cost.

Metal-Cutting Research

After reviewing the present state of knowledge of the mechanism of chip formation in metal-cutting, Paper 75, **Donald N. Gideon, Ralph Simon,** and **Horace J. Grover** conclude that the various assumptions that are made relative to the distribution of forces on the tool, on the chip, and on the workpiece are dubious. They suggest that an investigation be made to determine how the shear angle relationship ties in with cutting accuracy, tool wear, power requirements, and the like.

The same authors cover the thermal and physical aspects of metal-cutting in Paper 76. According to the authors, further research work in this field should include developing an accurate method of calculating tool forces, investigating the basic factors causing tool wear, and determining the exact nature of the shear process. Both papares were prepared as a part of the project "An Evaluation of the Present Understanding of Metal-Cutting" sponsored by the ASTE research fund at Battelle Memorial Institute.

Present knowledge of cutting fluids is summarized in Paper 79 by **S. L. Cosgrove** and **Roy W. Greenlee.** This paper is also based on ASTE-sponsored research. The authors evaluate the role of cutting fluids in some of the simpler cutting operations and examine the basic principles and experimental support for the several theories that have been advanced to explain the mechanism of cutting fluid action. The authors recommend further research into the mechanism of cutting fluid action, the effects of varying the rate of cutting fluid application and the extent of chemical reactions between chips, tool, and fluids. They also recommend that the penetration of fluids into the cutting zone be determined.

In another paper based on ASTE-sponsored research, Paper 80, **Francis W. Boulger** reviews what is known about the influence of metallurgical properties on metal-cutting operations. He concludes that the properties measured in tensile tests explain the machining properties of materials in a general way. However, the influence of metallurgical properties can best be determined by empirical testing methods simulating machining operations of greatest interest.

Five concise papers were presented in a metal-cutting research panel. These are available as Paper 83. **L. V. Colwell** discusses the meaning of tool life and the many variables that affect tool life. What can be done to assist industry in lowering metal-removal costs is the topic of **E. L. Fowler. R. E. McKee** illustrates the need for basic research in metal-cutting. **Kenneth Trigger** and **B. T. Chao** analyze flank wear in the machining of cast austenitic stainless steels. **Norman Zlatin** suggests the conditions under which ceramic tools can best be applied.

Surface Finishes

Honing is the process usually associated with obtaining precision surface finishes for functional parts. **B. F. Bregi,** Paper 77, shows how the honing process has been applied to finishing gear teeth. This method, originally developed for improving the sound characteristics of hardened gears, removes nicks and burrs, improves surface finishes, and makes minor corrections in tooth shape.

In a more general approach to the honing process, **B. R. McConnell, Sr.,** explains how specified finishes can be obtained by honing. Data presented in the paper make it possible to tailor the operation to the finish requirements.

Numerical Control

Possibly no individual subject in tool engineering has recently attracted more attention than numerical control. There is evidence, however, that the majority of tool engineers do not fully understand the potential significance of numerical control for their own plants. The papers in the numerical control symposium were intended to show what types of numerical control equipment are available and how they can be applied.

The symposium started with a talk by **T. W. Black,** Paper 84, in which some of the common misunderstandings about numerical control are cleared up and the basic principles and terminology of control systems are explained. As pointed out by **R. V. Benaglio,** Paper 85, numerical control or, more specifically, continuous contour control, offers a number of immediate advantages in the machining of complex production parts, molds, and dies. These include reduced tooling costs and lead time, better repeatability and potential accuracy of finish, ability to make and remake parts of complex design, previously not practicable or feasible, and reduced requirements for skilled machine operators. A complete numerical control system is described.

The machine tool as the controlled element in numerical control is discussed by **J. R. Ballinger,** Paper 90. He points out that the degree of control obtainable is virtually unlimited; it is up to tool engineers to determine the economic feasibility of various control systems.

L. S. Peck's subject is the potential of numerical control in manufacturing operations, Paper 91. He shows how numerical control has been applied to the manufacture of templates and similar parts and indicates dollar savings over conventional methods.

Numerical control for templates and dies is the topic of a talk by **Darwin H. Bingham, Jr.,** Paper 96. Production experience on numerically controlled machine tools is outlined by **F. Booth,** Paper 97. Contouring control from numerical data is covered by **John W. Wilson,** Paper 108. The system described operates on an "absolute analog" principle. Use of a computer in developing machine routines is explained. The tool engineer and tape preparation is the topic of a talk by **H. H. Schatz,** Paper 109. Programming for numerical control is covered by **Carl B. Perry,** Paper 111. The outcome of the first year's operation of a numerically controlled machine is outlined by **Bernerd Gaiennie,** Paper 110.

Diamond Tools

The papers on diamond tools deal with orienting the tool to obtain maximum life. Even the "softest" part of a diamond is harder than other known materials, but even greater life can be obtained by taking advantage of the crystallographic orientation of the diamond.

As pointed out by **Jan Taeyaerts,** Paper 93, diamonds are well-suited to resist abrasion and diamond tooling performs very well on soft and highly abrasive materials as brass, aluminum, lead, graphite, rubber, plastics, and the like. However, since diamonds are brittle and fracture easily, they may fail wherever cutting edge pressure becomes a factor, as in machining ferrous metals and hard bronzes. Rapid breakdown due to abrasion can be controlled by

proper stone orientation. When machining parts made of glass and epoxy resins, conventional diamond tools became dull after running an average of 3360 parts. Oriented diamond tools, on the other hand, produced an average of 6866 parts between sharpenings.

Resistance to fracture is obtained by orienting the diamond so that the cleavage plane is oriented parallel to the cutting force. Here, oriented tools give nearly double the life of conventional tools.

According to **Joseph Klipper**, Paper 99, oriented diamonds give maximum performance in formed dressing tools. Oriented sawn slabs outperform natural slabs ("maccle" diamonds) by a factor of 3½ to 1 and give more uniform performance.

Use of slabs instead of natural diamond shapes for single-point wheel dressing tools is also covered by **Harold C. Miller,** Paper 100. He cites several case histories that show that oriented diamonds are capable of doing a superior job of dressing flat and moderately contoured grinding wheels having a wide range of hardness and grit sizes. The relative cost picture is favorable to oriented diamond dressers.

A rapid method for setting diamonds in tools is described by **R. G. Weavind, C. J. Guykers,** and **A. R. Roy,** Paper 103. When using oriented diamonds, accurate setting is, of course, particularly important, and any movement of the tool when securing it in the tool shank must be avoided. Such movement is always a possibility when "powder press" methods of securing the diamond to the shank are used. In the method described by the authors, no pressure is used. The stone is first attached to the shank with an adhesive and then brazed on with an alloy that wets the surface of the diamond, giving it an excellent bond. Brazing takes five minutes in an argon atmosphere at a temperature of 1000 C.

Use of an X-ray image intensifier tube for orienting diamonds is explained by **J. F. H. Custers,** Paper 104. This method is much faster than the standard procedure of photographing the X-ray diffraction pattern and readjusting the crystal orientation on the basis of the photographic record obtained.

Guided Missile Program

Missile production presents new problems both to the product designer and the production engineer. In Paper 94, **Frank R. Swaney,** production engineer, takes a look at missile design. Mr. Swaney points out that when working with new materials and new product designs, extremely close cooperation between design and production engineering is essential. He describes how this cooperation is attained at his company and shows how some typical missile production problems have been solved.

A missile designer, **Emil A. H. Hellebrand,** discusses production in Paper 95. He explains the need for cooperation between design and production and shows how the production engineer's insistence on simplicity and producibility has resulted in improved missiles from both functional and manufacturing viewpoints.

Metal Powder Parts Symposium

The advantages of metal powder parts, economic factors and tooling are the chief topics covered in the metal powder parts symposium. **Frank J. DeMaine,** Paper 99, explains the effects of structural part design on tooling for sintered metals fabrication. The effect of the plastic flow of metal powders into dies is discussed and tooling simplification methods are illustrated. Common design limitations caused by such factors as size, radial projections, reentrant grooves, recesses, tapers, and threads are considered as they influence product design. Constructive collaboration between the metallurgist, product designer, and tool fabricator is recommended as a means of making sure that acceptable parts are produced.

Presses for powder metallurgy are discussed in Paper 105, by **James J. Kux.** With modern part designs and materials, it is no longer possible to rely on tabletting or punch presses for the majority of metal powder parts. A wide variety of mechanical and hydraulic presses intended for metal powder operations is currently available. The type of presses selected will depend on the characteristics of the part.

Briquetting tools for high-density iron powder parts is the topic of Paper 106 by **Robert A. Koehler** and **J. N. Smith.** The authors analyze the mechanism of pressing in relation to die design, density, and powder distribution. A specific tool—a multiple action briquetting tool—is discussed in terms of material selection, design limitations, tolerances, and press function.

Metal powder selection from the tool engineer's point of view is covered by **William L. Batten.** Mr. Batten points out that the designer has a wide range of characteristics and compositions to employ in fitting the right metal powder to the job. The tool engineer must provide the best tooling for the powder specified. The more alloy a powder contains, the more tool wear is likely to occur. The "ideal" powder for a given application is the powder that requires the simplest processing. Ordinarily, this powder will have a low apparent density, a fairly irregular particle shape, a low particle hardness, and good green strength.

Sintering is the most difficult of all powder metal fabrication steps. Not only are the problems common to the heating of solid metals involved, but also those that are unique to powder metallurgy, such as growth, shrinkage, effects of gaseous reactions, and alloying of solid metals. Sintering methods and equipment are given comprehensive treatment by **John H. Speck,** Paper 114.

Finishing operations for metal powder parts are discussed by **Peter E. Young,** Paper 115. These operations include straightening, sizing, machining, tumbling, grinding, sandblasting, and buffing. Special surface treatments against corrosion or wear are often used. Parts are also impregnated with oils and greases to provide lubrication and can be infiltrated with metals to give improved antifriction properties or greater densities. All of these processes are covered in some detail by the author.

New Drilling Techniques

As pointed out by **Hans Ernst** and **W. A. Haggerty,** Paper 101, conventional metal-cutting drills have no self-centering action. The chisel edge that connects the inner ends of the main cutting edges, lies in almost a straight line perpendicular to the axis of the drill. The surface generated by the chisel edge is therefore virtually a flat

highlights from the technical sessions

plane and the drill cannot center itself on engaging a workpiece. In the new spiral point drill geometry described by the authors, the entire flank surface associated with each cutting edge is formed as a "three-dimensional spiral" surface extending from the axis of the drill to its periphery. The chisel edge is gone and in its place is a characteristic S-shaped cutting edge. According to the authors, the new spiral-point shape is self-centering and has an improved cutting action.

While gun type tools are not a new development, tool designs have been consistently improved over the past several years. Improved gun drills and reamers and their applications are discussed by **Herbert Gregg,** Paper 102. Numerous fully documented case studies are presented.

European Tool Engineering

There can be no doubt that European tool engineers are keeping in close touch with American and other foreign developments and they are also coming up with some interesting developments of their own. Recent European metalcutting investigations are the subject of a talk by **Milton C. Shaw,** Paper 112. He notes that German tool life investigations have been concerned not only with measurement of the wear land that develops on the clearance face of a tool but also with the size and shape of the crater that forms on the tool face. These studies have led to useful empirical rules for crater formation.

Considerable work has been done on the influence of heat treatment of the workpiece on wear land and crater development. The tool life characteristics of a sinusoidally shaped tool have been studied and compared experimentally with results for conventional tools. This type of tool was originally developed in Russia and claims were made that it would have 80 times the life of a conventional carbide tool. Laboratory work shows that this claim was extravagant, but a modification of the design may prove of interest for high-speed disposable tools designed for total destruction, where crater wear is apt to be critical. The use of cast high-speed steel tools, another European development, offers many significant advantages and should be further investigated in this country.

The facts that European tool engineers are extremely capable and European manufacturing methods are up to date are stressed by **John W. Greve** in Paper 113. Mr. Greve's findings are based on recent visits to a number of European metalworking plants.

Titanium

When titanium was first introduced as an aircraft material, little was known about its machining and forming characteristics. Experimental work and production experience have now amply demonstrated that manufacturing problems are not nearly so formidable as they initially appeared. In Paper 118, **G. W. Bauer** gives the latest information on machining titanium. The hardness of titanium ranges from 50Bhn for very pure material to 500 Bhn for age-hardened alloys. Titanium has low thermal conductivity so there is a tendency for tools to weld to chips. Titanium's modulus of elasticity is about one half that of steel; consequently, more rigid backing of the workpiece is required. The general recommendations for machining are: use sharp tools and rigid machines, use slow speeds and heavy feeds, and use suitable lubricants. Specific recommendations for turning, milling, drilling and tapping, grinding, and sawing are made by the author.

Cold extrusion of titanium shapes is feasible, according to **Alvin M. Sabroff, Rocco A. Sannicandro** and **Paul D. Frost** in Paper 119. Experimental work described by the authors indicates parts with essentially uniform structure and properties over the cross section can be produced.

Automation

It would be difficult to obtain any general agreement on a definition for the word "automation." The scope of the papers delivered by speakers in the automation sessions shows that automation—whatever it is—is being applied to nearly all fields of manufacture. **James C. Keebler,** Paper 116, discusses machinery and automation, pointing out how machine design is being affected by automation and how automation is being affected by machine design. Numerous examples are given.

William C. Allen shows how close cooperation between product designers, tool engineers, and market research personnel is required to develop economically feasible automation systems, Paper 117.

Types of automatic assembly equipment is the subject of Paper 122 by **Lloyd L. Lee.** He shows how, for a given application, a choice is made among a rotary index, transfer type, table-top index type, or over-and-under in-line type of assembly machine. Each design has advantages and disadvantages.

According to **Don A. Cargill,** Paper 123, the goal of industry is the automatic factory. This can be realized through employment of integrated lines that combine conventional machine tools with automatic materials handling equipment. Such lines have automatic over-all control systems, and incorporate automatic gaging, parts feeding, and in-process storage where required. Several examples are given.

High-production automation through low-speed mechanisms is the provocative subject selected by **Julian Wille,** Paper 126. Mr. Wille points out that most high-production machines necessarily lose time because of the need for stopping for loading. His suggestion—applicable to rotating-turret machines—is to carry the parts on a conveyor that travels at the same speed as the turret. Thus, the relative motion of turret and part is zero. This permits continuous operation.

J. H. Brems, Paper 127, shows how welding automation is accomplished on special machines. Machining, forming, stamping, piercing, assembly, preheating, postheating, and cleaning operations can be combined with welding operations on a single machine.

Simplified setups for job-shop automation are explained by **Raymond Sollohub** and **Robert Coen,** Paper 131. They show that when a number of similar parts are being processed, there are usually product design constants that can be taken advantage of in introducing automation. Numerous examples are described.

By designing special machines with quick-change fixturing and other features, it is possible to use the same basic machine to produce several part designs, as demonstrated by **Howard N. Maynard,** also in Paper 131. In the same paper, **Ralph Eshelman** asks, and answers positively, the question "Can the small plant afford automation?" A fourth talk published with Paper 131 is a discussion of automation as applied to small-lot production, by **Werner O. Miller.**

Space-Age Tool Makers

honored by ASTE

Four modest men whose precision tooling work has put them in the vanguard—rather, the Explorer!—of the space age were honored at the on-campus college-industry conference held at the State University of Iowa.

As their work literally flew high over their heads, they stood before the conference luncheon crowd in the university's Memorial Union at Iowa City April 12 and received special citations from ASTE Vice President H. Dale Long. The four employees of the SUI physics department were cited by the Society and the university for fabricating the components of the tiny but terrific "magnetic memory" tape recorders used in the Explorer satellites.

The spatial tooling experts—Joseph Sentinella, Ed Freund, Bob Russell, and Bob Markee—have built five of the tape recorders, including the latest version orbiting in Explorer III, in the machine shop of the SUI physics building. Working at very close tolerances indeed, and producing a device that weighs only eight ounces and is only two and a half inches across, the four put in more than 500 manhours on each recorder. The delicate mechanism, designed by Iowa graduate student George Ludwig under the direction of the renowned satellite specialist Prof. James Van Allen, had to be infinitely tough and precise—it had to survive the shock of being rocketed spaceward, and once up there, to perform accurately for two months and over a total mileage in the millions.

The job of the tiny recorder is to report a continuous story of cosmic rays met during the 30,000-mile orbit of the earth. It stores up to two hours of space information, and plays it back upon signal in a five-second period when the satellite is within range of an observing station. Then it erases itself almost instantaneously and begins recording again for the next orbit.

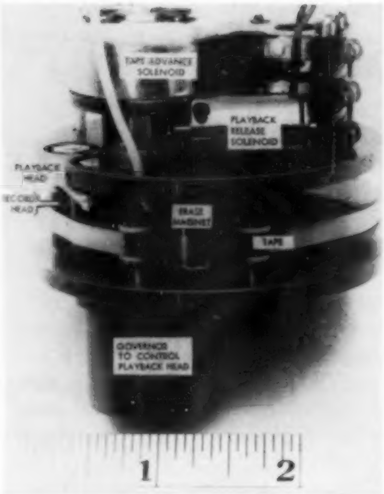
The Iowa tool engineers used magnesium to make the casing of the recorder and the plates on which its parts rest. Ratchets and screws are of stainless steel, supporting shafts of an alloy of 70 per cent magnesium and 30 per cent stainless steel. The release coil is of Swedish iron. The tape itself, which is only $\frac{5}{32}$ of an inch wide and $\frac{1}{1000}$ of an inch thick, is of a phosphoric bronze alloy (for springiness), thinly coated with cobalt.

Short-Run Experts

Among the hundreds of parts are 19 tiny ball bearing assemblies, the only components besides the tape which were not made in the Iowa shop. There are 10 thin brass gear wheels in the mechanism. The major parts are the recording and playback heads, the advancing and releasing coils, the magnetic "brake," the "erase" magnet, and the watch spring which rewinds the tape back to its starting point after a playback is triggered. The longest dimension in each of these parts is less than one inch.

Joe, Ed, and the two Bobs probably came nearer than any of the 70 tool engineers at the conference to qualifying as short-run tooling experts. (The subject of the on-campus meeting was "Tooling for Short-Run Applications.") Among them, they total

Vice President H. Dale Long (left) of ASTE gives certificates of recognition to State University of Iowa tool makers who fabricated parts of the "magnetic memory" tape recorder in Explorer III. Honored at the on-campus conference were (from left) Joseph Sentinella, Bob Russell, Bob Markee, and Ed Freund.



Satellite's tiny tape recorder measures 2½ inches wide, weighs only 8 ounces.

65 years of experience in machine tool work, most of it fabricating precision experimental parts.

Missile-Minded Meeting

In the rarefied atmosphere of SUI, which has sent campus-made scientific equipment high over the earth 79 times since the International Geophysical Year began July 1, 1957, it was perhaps natural that the fourth annual on-campus conference sponsored by the ASTE should be missile-age minded. In addition to the recognition of the four university instrument makers, the program featured two speeches which were take-offs on upper atmosphere problems.

Col. Earl S. MacDonald from Strategic Air Force headquarters at Omaha, Neb., spoke after dinner on "SAC Operation and Missile Use." His vivid and comprehensive portrayal of SAC's role in free world survival elicited edge-of-seat attention and many questions from the audience. He asserted that the United States got its strategic warning from Russia a hundred years ago, with the issuance of the Communist Manifesto; now, he said, SAC stands by for a tactical warning only. The colonel detailed SAC's arsenal of missiles and the nation's tenuous place in the missile race, and gave figures on the present combat readiness of the corps' craft and crews. He stressed the critical need of additional runway space to get enough planes off the ground in case of a short tactical warning.

Carl F. Burling, sales manager of the Lindbergh Engr. Co., Chicago, described furnaces as tools in the special heat treatment of metals for the jet and missile age. The demands of the new age, he noted, are higher and higher temperatures; automatic control of atmospheres for cleanliness; more mechanization in installations; and a trend toward package installations.

Malcolm Judkins, director of New Products Development, Pittsburgh, spoke on "Machining of Titanium, Zirconium, and Other Light Metal."

Tips for Tool Engineers

John L. Wright, for eight years tool engineer for the Collins Radio Co., Cedar Rapids, Ia., lifted the temporary tool from the status of a "dirty word" in his talk on "Low Cost Dies, Jigs, and Fixtures." He had a couple of tips for tool engineers: it's as much their duty to avoid building tools as it is to build them; and, don't trust memory on anything but record every idea and technique.

Other speakers included Paul Smith, field engineer for U.S. Gypsum Co., Kansas City, Mo., on "Applications of Epoxy Resins in Tool and Die Manufacturing"; R. A. Perkins, secretary of Kearney and Trecker Corp., Milwaukee, on "Leasing Vs. Purchasing Equipment"; Jack Rausch of Rausch Mfg. Co., St. Paul, Minn., "Economies of Using Investment Castings"; J. C. Dixon, Pratt & Whitney sales engineer of West Hartford, Conn., "Tape Controlled Jig Borers"; and R. P. Lindgren, district manager, Lincoln Electric Co., Cleveland, "Economic Applications of Arc Welding Developments to Fabrication."

Vice President Long urged the conferees to utilize fully the magazine, books, literature, and meetings of the ASTE in cultivating "your most precious asset—a normal functioning mind." Prof. K. J. Trigger, department of mechanical engineering of the University of Illinois and representative of the ASTE education committee, also spoke. Walter F. Loehwing, dean of the graduate college at SUI, welcomed the registrants. Prof. J. Wayne Deegan of SUI presided at the morning sessions; William S. Roush, chairman of Des Moines chapter, presided during the afternoon.

Tool engineers' wives attended a six-session program during the day.

Driving home a point in his talk on "SAC Operation and Missile Use" is Col. Earl S. MacDonald (left), Offutt Air Force Base, Omaha, Neb. Tossing a joke over his shoulder during his coffee talk at Iowa conference is Prof. K. J. Trigger of the University of Illinois, member of the ASTE education committee.

In the National Spotlight

NEWEST CHAPTER: Central Connecticut

Presentation of charter to newest ASTE chapter, Central Connecticut #148, is made by President H. E. Collins to Chairman Kenneth E. Sullivan at charter meeting April 2 in Waterbury Country Club. Hartford, sponsoring chapter, gave $250 to the new group of 198 members. New officers, sworn in by Mr. Collins, also included John Cameron, first vice chairman; Raymond Hanna, second vice chairman; Alred Fasula, secretary; and Frank Seidler, treasurer. National Director Phil Marsilius acted as toastmaster and H. E. Linsley, of *American Machinist*, was the main speaker.

TOOLS for SCHOOLS: New Government Program

Surplus machine tools—lathes, milling and grinding machines and related equipment—which are currently becoming excess to government requirements, are slated to take a new lease on life with a stepped up industrial training program for the nation's youth. Instead of clogging the industrial market, they will be channeled into manual training labs, vocational machine shops, and industrial engineering department of secondary schools and colleges where much of the present equipment has been found to be either obsolete or inadequate.

The announcement was made by H. B. McCoy, administrator of the Business and Defense Services Administration. Actual distribution will be handled by state agencies for surplus property within the state, which work with the U.S. Department of Health, Education and Welfare.

The BDSA, which assists in excess property disposal, will, through its Metalworking Equipment Division, review the schools' needs with an eye to insuring that applicants receive equipment suited to their individual requirements.

In the past twelve months, the changing pattern of defense production has made about 13,000 machine tolls excess to government needs, a rate expected to be equalled or exceeded in the future.

In addition to expanded youth training facilities, the program has a defense mobilization aspect, in that it will result in a dispersal of machine tools, important in the event of attack on this country.

San Diego chapter's **Alan M. Fullerton** heads up the new slate of SPI officers as 1958 chairman.

Through Mr. Guerreiro's efforts, in large part, committees of this SPI group have made notable progress toward the creation of standard techniques in plastic tooling for aircraft and also in the establishment of standard test methods for plastic tooling materials.

Dresden Smith has recently become a registered professional engineer. He is development engineer with Sperry Gyroscope Co. in Sunnyvale, Calif. He served as editorial chairman of Santa Clara Valley ASTE chapter and later as professional engineering committee chairman. He is a member of San Jose State College Engineering Alumni Association.

Charles Karrer, Detroit chapter, and his brother Eugene have each won a Sloan fellowship in the executive development programs at Massachusetts Institute of Technology. Under the fellowships, they will attend an intensified twelve-month course, designed to develop good industrial managers, drawing full pay meanwhile from their employers.

Charles is chief process engineer at Detroit Diesel Co. and an assistant on the automation committee of ASTE Chapter 1. Eugene works for Ford Central Engineering. Both are graduates of the General Motors Institute, Flint, Mich.

The MIT scholarships set up by the former head of GM, Alfred T. Sloan, are not restricted to GM employees. They are given out annually to only about 36 men in the United States and are based on over-all records of scholastic, social, and community attainments. Charles is 35 and Eugene, who is a member of the Society of Body Engineers, is 33.

members in the NEWS

Retiring National President **Harold E. Collins** of the Houston chapter was recently appointed to the National Defense Executive Reserve Board of the Metalworking Equipment Division, United States Department of Commerce. As vice president and manager of foreign operations of the Hughes Tool Co., Mr. Collins' broad experience in the machine tool industry will make him a valuable addition to this board. The Commerce Department's Metalworking Equipment Division has just been assigned the task of evaluating the needs of the nation's schools for machine tools, governmental surplus stocks of which are to be channeled to various levels of educational institutions in order to bring their equipment up to date and extend their facilities.

Six members of Fond du Lac chapter have been promoted at the Giddings & Lewis Machine Tool Co. The changes affect the company and two of its divisions, both in Fond du Lac:

Edgar L. McFerren has been named vice president-sales for the corporation. He was formerly general manager of the G&L and Hypro Div.

George K. Cassady has been made general manager field sales for the corporation. Succeeding him as general manager of the Davis Boring Tool Div. is **Walter B. Wigton,** who has been chief engineer of the G&L and Hypro Div. Filling the position vacated by Mr. Wigton is **Walter L. McCann,** formerly assistant chief engineer.

William M. Ritter was assigned the position of sales manager of the Davis Div.

Harry C. Soukup is acting general manager of the G&L and Hypro Div.; he will continue also in his capacity of works manager of that division.

Fred Boller, Keystone chapter, has been promoted to senior product engineer at Daystrom Instrument Corp., Archbald, Pa.

After six years as production engineer, Mr. Boller's new position requires project leadership in development of new products. He was previously with H. A. Lougee, electronic consultant engineers firm of Boston, and Western Electric Corp.

Hohman Plating & Mfg., Inc., announces the appointment of **Karl A. Wildason** of Dayton chapter as sales manager. He will direct sales activities of Hohman's solid film lubricants and production metal-finishing service.

Prior to joining Hohman, Mr. Wildason was cofounder and operator of the Dayton Re-New Tool Co.

K. A. Wildason

Fred Boller

Reuben Cribbs, treasurer of Keystone chapter, has been appointed sales engineering supervisor of El-Tronics, Inc., Mayfield, Pa.

After six years as manufacturing and project leader at Daystrom Instrument, project engineer at Jacobs Aircraft, tool engineer with Avco, Lycoming Div., and four years as instructor at Clearfield Aviation Vocational School, Mr. Cribbs' new duties will entail filling position as chief estimator, assistant to factory manager, and acting as sales administrative consultant, dealing with factory and customer problems.

It has been announced by Trojan Industries that **Nicholas Kondur** of Chicago chapter has been named vice president and general manager, and elected to the board.

Mr. Kondur has served in executive capacities with the Crane Co. as manager of the Methods and Equipment Div. He previously was general manager of various divisions of F. L. Jacobs Co. in Danville, Ill., and Traverse City, Mich.

Prior to joining Jacobs, Mr. Kondur served General Electric Corp. as plant manager of the Pittsfield and Springfield, Mass., operations.

The appointment of **Spencer D. Reed,** Binghamton chapter, to administrative assistant to the Endicott Plant superintendent has been announced by International Business Machines Corp.

Mr. Reed started with IBM in 1937 as a toolmaker. Since then he has held many positions in the firm from model maker in the engineering laboratory to a spot on the general manager's staff, the position held just prior to his new appointment.

Reuben Cribbs

Spencer D. Reed

chapter news and views

Two-Day Seminar On Instrumentation Planned in Detroit

New instrumentation requirements in metal-cutting will be the theme of a projected two-day seminar June 26-27 at the Horace H. Rackham Auditorium in Detroit and the College of Engineering, University of Michigan, Ann Arbor.

The seminar will be jointly sponsored by the ASTE and the Foundation for Instrumentation, Education, and Research, Inc. The ASTE's research and educational leaders will be responsible for providing four or five participants to present papers on the first day of the seminar concerning "Control Problems in Industry." The second day of the program will consist of additional technical papers presented by leading research, industry, and education people, and an open forum discussion. The conference fee will be $25, including meals and collected papers of the program.

The seminar aims to unearth some possible projects for research in metal-cutting instrumentation and, in addition, to test the idea of a subsequent larger national symposium on the subject. An exchange of thoughts and information is the basic goal of the seminar.

Instrumental in planning the conference were Lloyd E. Slater of FEIR; Professor L. V. Colwell and R. E. Carroll of the University of Michigan; and Gilbert E. Seeley, national education director of the ASTE.

JACKSON—Retiring Chairman Glenn Barry (left) receives a presentation from the new officers of the chapter: William J. Levy, chairman; Julien J. VanMaele, first vice chairman; Darrel Hatt, second vice chairman; Fred Dutton, secretary; and Norman Peterson, treasurer.

ROCKFORD—Past Chairman Walter Fraser turns chapter gavel over to Chairman Marshall Samuelson. Other new officers: Ernest Norrman and Walter Lewis, first and second vice chairmen; Lawrence Geiger, treasurer; Lester Teachout, secretary; Leslie Monson, third vice chairman. —*Kenneth R. Bookland*

LITTLE ROCK—Literally backing up new chairman, Clarence Reed, are (from left) Garland Shepherd, first vice chairman; John Jones, second vice chairman; and Marion Harden, treasurer. New Secretary Gordon Cooper was not present.

—*B. Foster*

CENTRAL PENNSYLVANIA—Forty-seven students from Scotland School were the special guests of the chapter for a tour of the U.S. Naval Ordnance Plant in York, Pa. Dr. O. Meredith Parry, principal of William Penn High School, spoke to the group.
—Harold B. Berra

New Chapter Officers Are Listed

CENTRAL CONNECTICUT: Ken Sullivan, chairman; Raymond Hanna, second vice chairman; Alfred Fasula, secretary; Frank Seidler, treasurer.

FORT WAYNE: Richard G. Shaw, chairman; Alfred E. Peterson, first vice chairman; Robert H. Bienz, second vice chairman; Elmer W. Pfister, secretary; D. Allen Bauer, treasurer.

GRANITE STATE: Fred Wakefield, chairman; Robert Ellison, first vice chairman; Richard Downing, second vice chairman; Dennis Haine, secretary; Rudolph Fanaras, treasurer.

LITTLE RHODY: Gilbert Stafford, chairman; Bertrand Guindon, second vice chairman; Maurice Schoos, secretary; Richard Kilbane, treasurer.

WESTERN MICHIGAN: James R. Wagner, chairman; James J. Rost, first vice chairman; Edwin Stouten, second vice chairman; Harold D. Wind, secretary; Ivan J. Haan, treasurer.

BIRMINGHAM: Walter Krug, chairman; William R. Gillies, first vice chairman; Homer Hooper, second vice chairman; J. E. Wilkinson, secretary; William E. Webster, treasurer.

HOUSTON: S. E. Rees, chairman; C. K. Hay, first vice chairman; Harry Betts, second vice chairman; A. G. Meyer, Jr., secretary; A. F. Huge, Jr., treasurer.

LA CROSSE: Elden Bruha, chairman; William Nichols, first vice chairman; Burton Hanson, second vice chairman; Ervin Crogan, secretary; Orville Kile, treasurer.

LIMA: Gene Siferd, chairman; Vince Spahr, first vice chairman; Don Cox, second vice chairman; Bill Waters, secretary; Wilbur Brillhart, treasurer.

PHILADELPHIA: H. O. Fullam, chairman; W. De Maris, first vice chairman; L. Horoff, second vice chairman; H. J. Lueders, secretary; E. A. Lund, treasurer.

PHOENIX: Walter Noren, chairman; John Hamay, first vice chairman; Julian Wille, second vice chairman; Walter Cole, secretary; Titus Zomborean, treasurer.

ATLANTA: H. P. Ulrickson, chairman; Ray Culver, first vice chairman; Ed Dattler, second vice chairman; William Matthews, secretary; Paul Kight, treasurer.

BINGHAMPTON: Charles King, chairman; Robert Carbrey, first vice chairman; P. J. Adamek, second vice chairman; Glynn Williams, secretary; Joseph Pokorak, treasurer.

BOSTON: John Morosini, chairman; Nick Julianni, first vice chairman; Joseph D'Avella, second vice chairman; Jack McAvoy, secretary; Seymore Benedetto, treasurer.

CINCINNATI: Julius Steinhoff, chairman; Broadus Rusk, first vice chairman; Frank H. Houston, second vice chairman; Frank Kutz, secretary; Joseph Williamson, treasurer.

DES MOINES: William S. Roush, chairman; Oscar A. Olson, first vice chairman; Don Waggoner, secretary; Walter Cocks, treasurer.

ELKHART-GOSHEN: Charles N. Wolf, chairman; Charles F. Kelly, Jr., first vice chairman; William Selick, second vice chairman; Robert L. Claybaugh, secretary; Edward E. Long, treasurer.

EVANSVILLE: Herman Muehlbauer, chairman; Charles Hinman, first vice chairman; John Schaus, second vice chairman; Paul Bertram, secretary; Walter Lockmueller, treasurer.

SACRAMENTO: Arthur Dzigorski, chairman; Robert E. Dailey, first vice chairman; Edwin J. Hofferber, second vice chairman; Jack L. Lowrey, secretary; Raymond Goundry, treasurer.

SAGINAW VALLEY: Pete Duch, chairman; Frank Faga, first vice chairman; Kent Arnold, second vice chairman; Elmer Mieskowski, Secretary; Nick Bereznoff, treasurer.

SAN ANTONIO: C. H. Chiodo, chairman; W. A. Lange, first vice chairman; J. B. Frix, second vice chairman; Richard Pierce, secretary; Joe Gueldner, treasurer.

SOUTH BEND: Fred Goss, chairman; Richard Wachs, first vice chairman; Tony Hoefle, second vice chairman; Robert Slack, secretary; Richard Marshman, treasurer.

SOUTHEAST KANSAS: Rex B. Sears, chairman; Fred Savage, first vice chairman; Bernard Wade, second vice chairman; Warren Welch, secretary; John Mahaffy, treasurer.

SPRINGFIELD, Ill.: Forrest D. Hodge, chairman; Donald A. Korte, first vice chairman; Robert C. Newell, second vice chairman; Roy Kern, secretary; Robert N. Woods, treasurer.

SPRINGFIELD, Mass.: George H. Foy, chairman; Allen H. Johnson, first vice chairman; Thomas E. Ruddeforth, second vice chairman; Joseph P. Giblin, treasurer; Andrews Clark, treasurer.

LONG BEACH: C. W. Ward, chairman; G. C. Allen, first vice chairman; I. P. Also, second vice chairman; C. D. McNealy, third vice chairman; L. W. Allen, secretary; O. E. Mueller, treasurer.

LONG ISLAND: Jerome Barfus, chairman; Sheldon Meyers, first vice chairman; Don Griffing, second vice chairman; William H. Bruning, secretary; Charles H. Vanderhoof, treasurer.

MEMPHIS: Floyd Garner, chairman; Roy Beers, first vice chairman; Richard Christman, second vice chairman; Walter Rickard, secretary; Henry Kidd, treasurer.

TRI-CITIES: Albert C. Vande Walle, chairman; Robert M. Larson, first vice chairman; Clifford C. Vogt, second vice chairman; Don Johnson, secretary; Louis Benson, treasurer.

HARTFORD: Paul Dillberg, chairman; Paul Pick, first vice chairman; Howard Wheeler, second vice chairman; Doug Proctor, secretary; Lee Giardi, treasurer.

Edward J. Huttenga Honored at Muskegon

Muskegon chapter's Outstanding Achievement Award has this year been presented to Edward J. Huttenga for his unstinting contribution of time and effort to promote Society activities within the community.

Mr. Huttenga, who is director of vocational guidance for Muskegon Public Schools, arranged the chapter's Student-Industry Day program, attended by 350 high school and college students in the Muskegon area. This highly successful event was described at length in the January issue, page 143.

Mr. Huttenga's award was based not solely on his efforts in organizing the student program, however. He has also helped promote adult education classes, sponsored by the public schools and the Muskegon Manufacturers Association, with emphasis on tool engineering and industrial management. The local ASTE chapter voted unanimously to support this adult program, and many members have enrolled in it.

Two years ago, Mr. Huttenga was instrumental in setting up a cooperative pre-engineering course in the Muskegon Community College. Thirty-one students enrolled the first term, attending classes in the morning and working in the afternoon in plants specializing in their particular fields of engineering. Students will continue on a four-year college engineering course.

—D. G. Fredricksen

Disney Consultant Speaks on Space Age

Dr. Heinz Haber, chief science consultant of Walt Disney Productions and noted lecturer and author, captivated an audience of 134 San Fernando Valley members with the subject "Why Should We Conquer Space?" He described how simple it would be for either of the dominant world powers to contaminate outer space by exploding fragmentary missiles in orbit, thereby creating orbiting particles which would jeopardize man's adventure into outer space.

Dr. Haber stressed the importance of educating young scientists in planetary engineering so that satellites could be used for peaceful purposes such as the study of the earth's atmosphere. Informative data collected by tape recordings from orbiting satelites could furnish information capable of controlling weather, varying the paths of hurricanes, and thus solving water problems benefiting millions of people.

—Robert E. Ditrick

LOUIS JOLIET—Vice president Dale Long (left) congratulates newly installed officers: (from left) Donald F. Domnick, first vice chairman; Paul E. Wasser, chairman; William L. Neuman Jr., second vice chairman; J. Willard Drazy, treasurer; and Robert E. Rice, secretary. *—Harry Colburn*

SAN FERNANDO VALLEY—Newly elected officers happy at the prospect of the forthcoming term are (from left) Glen Crider, secretary; Robert A. Edgecomb, second vice chairman; John R. Bethune, chairman; Tommy Tomlinson, first vice chairman; and Sam C. Longo, treasurer. *—R. E. Ditrick*

TRENTON-DELAWARE VALLEY—Shown from left are new officers Robert Poole, secretary; Morris Bahr, first vice chairman; and Robert Petersen, chairman, being congratulated by Richard Nolan, retiring chairman backed up by Edward Londahl, the second vice chairman. Treasurer Konrad Richter was not present for the picture. *—C. H. Meyer*

Chips and Chatter

SANTA CLARA VALLEY—Frank J. Lamphere of the Charles Bruning Co. explained what optical tooling offers to tool engineers, illustrating his talk with an industrial academy award movie showing the principles of optical tools for measuring, aligning, and positioning. Mr. Lamphere was a member of the original aircraft optical tooling panel of the Aircraft Industry Association.

—G. N. Major

Detroit

At the Mar. 20 meeting in the Rackham Building, Kenneth C. Butterfield, staff master mechanic for Chrysler Corp., spoke on "Tool Engineering, the Stepping Stone to Careers in the Automotive Field." Mr. Butterfield discussed the various departments and sections in which the tool engineer would fit in order to progress into the management level; also how the tool engineer is allied and/or related to the various departments in the automotive industry. Following his presentation a movie was shown on the activities at the Chrysler Proving Grounds at Chelsea, Mich.

Mississippi

At the installation meeting Mar. 15, held at the Heidelberg Hotel, G. R. Calla, president of Dilworth; and Thurston Walls, professor economics, Milsaps College, spoke on "Economic Trends of Today." Their talk was accompanied by tool and die film.

Lima

On Mar. 20, installation night at the Clemans Bldg., 70 members heard Harry F. Fussner, sales manager of the Threading Tools Div., The National Acme Co., discuss thread rolling, chasing and burnishing inside and outside; also the machinery, rate of production and problems involved in the above processes. His talk was highlighted by the use of slides and actual production parts.

North Shore

"Modern Tooling—the Key to Reducing the High Cost of Producing Accurate Holes" was the subject of a technical talk given by G. Thomas Hearn, manager of DeVlieg Microbore Div. of DeVlieg Machine Co., at the Mar. 11 meeting at Lynn Yacht Club. A short film on "Hunting in Newfoundland" followed Mr. Hearn's presentation.

Jackson

At the Arbor Hills Country Club on Mar. 17 members heard Malcolm F. Judkins gave a talk on "Nuclear Energy."

Golden Gate

John Gibson, product manager for Reliance Magnesium Co., was the speaker installation night Mar. 19 at Spenger's Fish Grotto. His subject, "New Era in Tooling through Magnesium," was heard by 105 members.

Piedmont

A buffet dinner, annual dinner dance and installation of officers were the main events at Thomasville Woman's Club, Saturday evening, March 15.

Riverside

Ben Berlien, national director of ASTE, gave an informative talk on "Mechanical Properties and Heat-Treatment of Steels" at the Mar. 11 meeting held at Mike's Cafe. Following Mr. Berlien's talk, new officers for the coming year were installed.

Milwaukee

At the Mar. 13 technical meeting, held at the American Serb Memorial Hall, 120 members heard Frank L. Suchanek of Sundstrand Magnetic Products Co. talk on magnetic devices used for holding workpieces for machining operations. His talk was accompanied by movies.

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SPECIAL EVENTS

ASTE West Coast Tool Show.
Sept. 29-Oct. 3, Los Angeles Shrine Exposition Hall.

Automation Seminar, Penn State.
June 9-13. Penn State University, College Park, Pa.

Instrumentation Seminar.
June 26-27, Detroit and University of Michigan, Ann Arbor.

Position Wanted

EXECUTIVE ENGINEER—Twenty years' diversified experience in financial, sales, engineering and production in the metal fabrication and machine tool industries. Seasoned in large appliances, automotive, plastics—extrusion, laminated phenolics, compression molding. Write to: Box 118, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

CHAPTER MEETINGS

PLACE	June	SPEAKER	SUBJECT
Akron. Loyal Oak	13		Golf outing
Binghamton. Hillendale Country Club	21		Second annual outing
California State Polytechnic College. 7:30 pm	2	**Donald M. Laflin** Giddings & Lewis Machine Tool Co.	Tape Control Machining
Chautauqua-Warren. Spencer Farm. 1 pm	21		Annual stag picnic
Des Moines. Golf & Country Club.	11	**Harry Conn,** Scully-Jones Mfg. Co.	Economics of Tooling and Manufacturing
Hamilton District. Dundas Golf & Country Club. 9 am	20		Annual field day with golf and dinner
Jackson. Cascade Golf Course. 7 am	7		Joint outing with ASM chapter
Lehigh Valley. Hotel Traylor. 7 pm	8		Ladies night; social hour
Little Rock. Hank's Dog House.	12	Representative of Teletype Corp.	Metallurgy
Long Beach. New Petroleum Club. 7 pm	11	**Tom Vajda,** Lockheed Aircraft	Methods for Missile Manufacture
Louisville. Western Lanes. 9 am to 1 pm	14		Bowling
Mansfield. Round Lake Golf Course	14		Picnic
Merrimack Valley. Andover Country Club. 7 pm	5		Ladies night
Mississippi. King Edwards Hotel. 7 pm	2	**Russell F. Novy** Lindberg Engineering Co.	Heat-Treating under Controlled Atmospheres
Montreal. Lasalle Golf & Country Club	18		Golf tournament
Muskegon. Prospect Point, Spring Lake. 6:30 pm	20		Dinner-dance
Northern Massachusetts. Twisters Fun Club Recreational Area, Orange, Mass. 10 am	28		Annual outing
Northwestern Pennsylvania. American Legion Home. 6:30 pm	5	**Lester R. Moskowitz** L. R. Moskowitz & Associates	Use of Permanent Magnets in Automation
Paterson. Anheuser-Busch, Inc. 7:15 pm	16		Plant tour
Peoria. Vonachen's Junction Restaurant	3	**B. A. Rogers,** Texas Engineer & Experiment Station	Atomic Energy and the Tool Engineer
Philadelphia. Fels Planetarium, Franklin Institute 8 pm	19	**I. M. Levitt** Fels Planetarium	"Trip to the Moon"; annual ladies night
Phoenix. Desert Hills Hotel 7 pm	9	**R. E. McKee,** R. K. LeBlond Machine Tool Co.	Science and Application of Metal-Cutting
Portland, Me. Falmouth Hotel. 7 pm	6	**Charles D. Brown** DieElectric Products Co.	High Frequency, Transmission, Filtering Devices, Antenna Systems, Plant tour
Portland, Ore.	21		Family picnic
Riverside. Dinner Horn. 6 pm	7		Ladies night
Rochester. Barnard's Firemens Exempt. 8 pm	9	**William Busch** L & S Co.	Flo-Turn Applications
Rockford. Mauh-Nah-Tee-See Country Club. 12 pm	26		Annual golf stag
Santa Ana. Palms Restaurant in Anaheim. 6:30 pm	3	**Wm. K. Lear** Rosan Inc.	General Application of Rosan Fasteners. Awards for tool design contest
Trenton Delaware Valley. Italian American Sportsmans Club. 1 pm	21		Annual picnic
Tri-Cities. Springbrook Country Club	14		Golf tournament, banquet
Worcester. Leicester Country Club. 10 am to 7 pm	21		Annual outing

HARTFORD—Carl G. Erickson (left), tool control engineer for Pratt & Whitney Co., West Hartford, Conn., is shown receiving his company's Charter Oak Award from Edward P. Gillane, Pratt & Whitney president. The award plus an honorarium of $50 was presented to Erickson for his authorship of "Powder Metal Shanks Reduce Chatter," which appeared in the March TOOL ENGINEER. Erickson has been an ASTE member since 1952, and is also president of the Society of Carbide Engineers for 1958.

Obituaries

Harry M. Adams, Detroit, consultant for Chrysler Corp.

Milton G. Bonner, Toledo, sales engineer for Morse Twist Drill Co.

Robert L. Dzibinski, Milwaukee, senior tool designer for Inland Steel Products Co.

Eugene R. Necker, Paterson, tool allocator, Wright Aeronautical, Woodbridge, N. J.

Melvin H. O'Dell, Saginaw Valley, toolroom supervisor, Lufkin Rule Co.

Omer C. Overholser, Elkhart-Goshen, assistant purchasing agent, Holdman and Collet, Inc.

Myron C. Sausaler, Lorain County, supervisor, Timms Spring Co., Elyria, Ohio.

Howard C. Shear, Denver, plant supervisor, Flexoveyor Mfg. Co.

William F. Wise, Detroit, April 18. Mr. Wise was president of Scotten Mfg. Co., Shop Tools, Inc., and Republic Realty Corp. He was formerly vice president of Ex-Cell-O Corp. and vice president and director of Avco Mfg. Co. He belonged to the Society of Automotive Engineers.

Merrimack Tour

Members toured the Western Electric Co. plant at North Andover, Mass., on April 3. They saw three movies: "Tools of Telephony," "Voices Under the Sea," and "Arctic Activities."

PROGRESS IN PRODUCTION

COMBINED MACHINING OPERATIONS SPEEDS CRANKSHAFT PRODUCTION

To simplify handling, increase efficiency of part production and improve versatility in machining forged steel crankshafts, Caterpillar Tractor Co. has condensed two machining operations and added specially designed mounting plates.

To meet its needs, the company processes in the same department crankshafts in 11 sizes of types ranging from four to six throws. Presently these forged steel crankshafts are handled on a single machine with tooling almost as simple as that for changing a cartridge clip on a rifle. The machine is a Wickes double-housing, 36-inch center-drive bearing lathe. Manned by one operator, it cheeks, turns and fillets all bearings, flanges and stub ends of each crankshaft simultaneously.

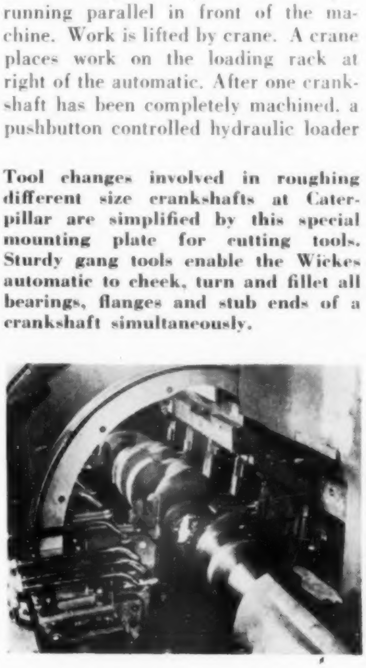
Until recently, two machines were required to handle the work—a center drive lathe for turning bearings, flanges and stub ends, and a double-end drive machine to turn all remaining intermediate bearings. Tooling involved as many as 33 cutting tools while accuracy of setup depended on abilities of an operator at each of the two machines.

An example of the new technique is a 505-lb forged steel crankshaft from which, during the roughing operation, the machine removes about 36 in. of stock or about 67 lb of metal. Power is supplied by a constant horsepower, two-speed motor.

Shifting to another type and size crankshaft is simple—retooling consists only of removing a special mounting plate, which holds the necessary cutting tools, and remounting another. Mounting plates are all pretooled for each type and size crankshaft to be machined and stocked in the tool crib.

For the machining operation, crankshafts are spotted by a floor conveyor running parallel in front of the machine. Work is lifted by crane. A crane places work on the loading rack at right of the automatic. After one crankshaft has been completely machined, a pushbutton controlled hydraulic loader unloads it from the left and picks up the next piece from the right.

Tool changes involved in roughing different size crankshafts at Caterpillar are simplified by this special mounting plate for cutting tools. Sturdy gang tools enable the Wickes automatic to cheek, turn and fillet all bearings, flanges and stub ends of a crankshaft simultaneously.



Once in the machine, the crankshaft is chucked on previously milled spots and turned at speeds from 18 to 24 rpm. Tool life, with the special high-speed form tools used, ranges from 10 to 50 crankshafts. Tools have a top rake of 15 deg and cutting rake of 7 deg.

After initial manual adjustment, feeds compensate automatically to meet whatever metal hardness condition is encountered in various lots of crankshafts or for changed crankshaft specifications. Feed mechanism is controlled electrically by adjustable cams working off the slides.

FASTER ROTOR PRODUCTION WITH FLAME CUTTING

Better brake rotors for jet aircraft are being produced faster at Alpha Industries as a result of standardization on flame cutting. The job formerly was fabricated by machine tool cutting in six part segements—now it is produced in one piece.

Production problem which had to be solved was whether 18 slots only $1/16$-in. wide could be accurately flame-cut. Performance of the precision cutting project required development of a new production method which hinged an ability of an Oxweld cutting machine and twin torches to make close tolerance shots $1/16$-in. wide in the steel blank.

Engineers of Alpha and Linde Co. worked out this production sequence: Two rotor profiles are simultaneously flame-cut by a CM-15-36 cutting machine from the $7/16$-in. thick steel blank. The machine mounts twin C-39 cutting torches side by side on a special

Slots 1/16-in. wide are precision-cut in 7/16-in. thick steel plate with the cutting torch.

90-deg adaptor bracket. The torches are guided by magnetic tracing equipment to assure maximum accuracy along the 18-in. inner and 42-in. outer circumference of the rotor blank.

Rotor blanks then are annealed and 24 holes drilled in each blank. Drilled blanks are placed on a rotating positioner and the cutting machine and the cutting torches combine to handle the precision flame-slotting operation. The cutting torch slices 36 in. of circumferential arc slots and 12 in. of radial slots—a total of 48 in. of exact 1/16-in. slotting per rotor. Only 11 minutes is required for slotting.

Following the slotting operation, rotors again are annealed and then rough ground, broached, countersunk, heat treated, finish ground and deburred.

GUN DRILL PRINCIPLE SPEEDS BORING OPERATION

To keep pace with other machining advances which speed modern production, Hartford Empire Div. Plant 3 of Emhart Mfg. Co. has adapted the principle of gun drilling to produce short and extremely accurate holes on boring machines. Results have demonstrated effectively that special machines are not essential to achieve successful straight and round holes with excellent finish.

Among ten different pieces that are gun drilled on a turret lathe as a routine practice at Hartford Empire, is a cast-iron part requiring a gun-drilled hole 14⅝-in. long and 1¼ in. in diameter. The part is chucked in a Jones & Lamson turret lathe on the large, previously turned diameter. The opposite end is then turned to fit the bearing of an outboard support. Spotting, drilling and boring a hole 1 in. deep the same size as the gun drill prepares the part for the gun drill which then is used to complete the hole. This particular piece (which is illustrated) is drilled on a turret lathe at 253 rpm with a feed of 0.005 ipr. The drill used incorporates carbide insert tip.

Savings in machining cost on this part has been estimated to be at least $9 per part as compared to previously used procedure. Scrap losses are considerably less than when it required seven separate operations to make the holes.

Formerly, after rough turning the large end and facing the flange, the flange end was chucked and a gun drill was used to drill a 1 7/32-in. hole with a different setup. The hole then was reamed to fit a broach, and the hole was broached to 1.252/1.250 in. Next, the part was put on an arbor and the large diameter and flange finished turned. Then it was turned around and the opposite hub end faced. A groove for an O-ring was machined on the stub arbor.

As a consequence, these engineers point out that the finest lathes, which have adequate power and latest type throwaway carbide insert tools operating at high speeds, are not being used to best advantage when machine operations include hole drilling.

EXTRUSION PROCESS SLASHES WHEEL COSTS

A method of extruding wheels around turbine blade roots by a heavy forging press is realizing tremendous cost savings at Ford Motor Co. The process could obsolete Ford's present practice of producing turbine and compressor rotors for jet and gas turbine engines by close tolerance broaching of both blade roots and blade root cavities.

Calculations show that wheels up to 30 in. in diameter can be produced by the process with a forging press of about 30,000 ton capacity.

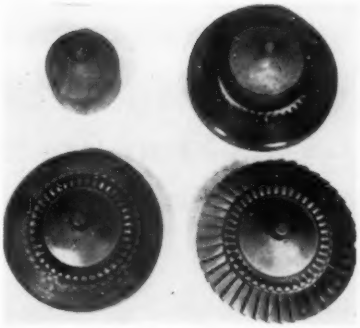
According to Lester I. Webb, engineer who developed the process, it was found during the search for a new method that "early experiments with clay were so successful that (engineers) were able to move directly to steel processing without in-between steps."

Consequently, turbine wheels already are being produced by Steel Improvement and Forge Co. in cooperation with Ford Engineering Research. A. H. Milnes, executive vice-president of the company, revealed that his firm is negotiating contracts to produce 6 and 9 in. axial turbine wheels at less than $100 each plus cost of blades.

Present methods involve close tolerance broaching of both turbine blade roots, in a fir tree configuration, and the blade cavities into which they fit. Tolerances for some jet engine turbine and compressor wheels range down as low as 0.0005 in.

With the extrusion process, broaching operations on the turbine blade root are unnecessary. If the airfoil blade meets specifications, the root end only need be in its original cast or forged shape.

An outside ring and an inner die are used to position the blades. Once properly aligned and indexed, space between the blades is filled with steel alloy that melts at approximately 700 F and which is allowed to solidify. The inner die then is removed and hot billet is extruded over, under and around the blade roots to make the wheel essentially complete. Only relatively minor machining is necessary to remove excess metal from the turbine wheel faces.

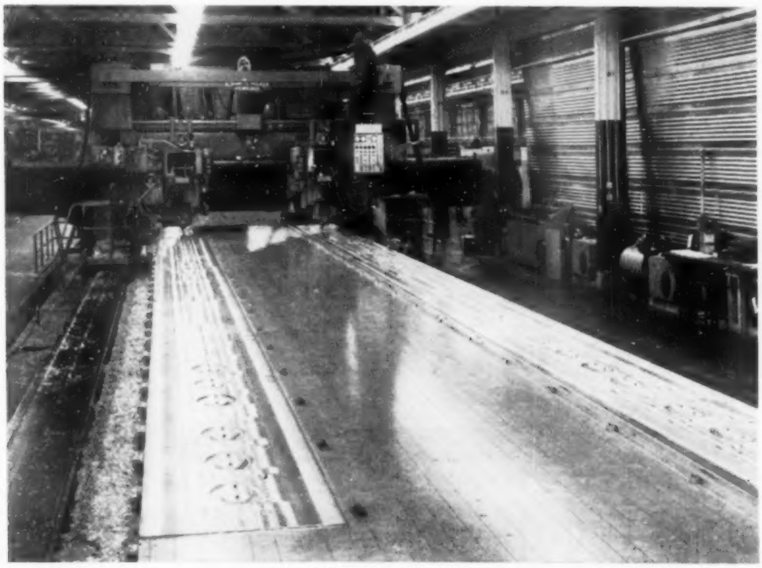


Four steps in the method to produce finished turbine wheels at a fraction of their present cost to Ford Motor Co. include a billet (top left) that is heated and extruded over and around blade roots to form the wheel hub; (top right) blades sealed in steel alloy after having been positioned and indexed; (lower left) completed wheel with the billet extruded around the blade roots; (lower right) wheel with steel alloy removed from between airfoil blades prior to face machining to remove excess wheel hub metal.

TAPE CONTROLLED EQUIPMENT ACCOMPLISHES INTRICATE SKIN MILLING JOB

Two sculptured wing skin panels for the Boeing B-52G Stratofortress are being produced simultaneously on a 12-80 ft Kearney & Trecker skin mill. All intricate motions of the giant mill are controlled by information on a magnetic tape. The integrally-stiffened wing panels are machined to extremely close tolerances.

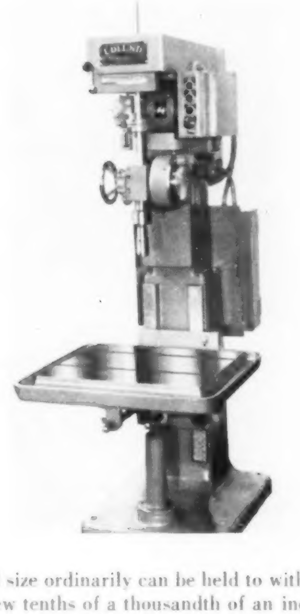
This skin mill is one of eight electronically controlled machines at Boeing's Seattle and Wichita plants which are using three such skin mills, three profile mills and two automatic riveters in production of the Stratofortress. Company officials point out that extensive use of such machines is allowing production at significantly reduced costs.



TOOLS of today

Gun Type Drilling Machine

A vertical gun type drilling machine, designated Model 2G, produces extremely straight, accurate and smooth holes at fast production rates in a single operation with continuous feed in materials that ordinarily work-harden during machining. Hole finish from 4 to 8 micro-inches can be obtained in most materials,



and size ordinarily can be held to within a few tenths of a thousandth of an inch.

The vertical spindle type machine lends itself to multiple spindle operations. Also, one gun drilling spindle can be combined with standard drilling spindles on a common base so that operations requiring one gun drilled hole and one or more regular holes can be performed at the same time. Odd shaped pieces that cannot be rotated can be drilled with the Model 2G, since the gun-type drill itself rotates.

Because of the machines' sturdy construction and its available high speeds, the latest advances in carbide tipped gun drills may be utilized.

Feed to the spindle is accomplished through a magnetic clutch which may be remote controlled and can be coordinated into automatic cycling operations.

Rated capacity of the machine is 5/8-in. Holes to a depth of 7½-in. may be drilled depending upon the size of tool and material. All types of materials, including aluminum, cast iron, bronze, stainless and all other steels can be drilled.

Edlund Machinery Co., 48 Huntington St., Cortland, N. Y. **T-6-1**

Welding Machines

Three welding units in 200, 300 and 500-amp models for a-c or d-c inert welding applications provide a wide range of working amperages that can be obtained accurately by a control dial while the machines are in operation. High frequency control speeds striking and stabilizes the arc whether a machine is operating in the low, middle or extreme ranges. The machines can be set up for: metallic arc a-c or d-c straight or reverse; Heliarc a-c or d-c straight or reverse; automatic Heliarc a-c or d-c; sigma or spot welding a-c or d-c. Spot gun controls as well as a remote control device are available as optional equipment on each unit.

Model A2000AD has an a-c range from 7 to 275 amp and a d-c range from 7 to 200 amp; Model A3000AD has an a-c range from 10 to 395 amp, d-c range from 7 to 300 amp; Model A5000AD

has an a-c range from 15 to 675 amp, d-c range from 12 to 500 amp. All three have an auxiliary power source with an output of 2 kw, 80 volts.

Welding Products Div., A. O. Smith Corp., Milwaukee, Wis. **T-6-2**

Nibbling Shears

Column-mounted electric throatless nibbling shear, which operates at 1725 cutting strokes per minute, is designed for quick accurate cutting, slitting and trimming. Throatless design permits the work to be turned in any position so that any shape such as curved, circular, irregular, angle or straight may be cut.

Three models are available: the smallest, Model BN-1, has a cutting capacity of 14 ga in mild steel, 18 ga in stainless; Model BN-2 will cut up to 10 ga mild, 14 ga stainless; Model BN-3 will cut mild steel up to 3/16 in., stainless steel to 10 ga.

A standard 30-in. column and base places the working table at bench height. A bench base, (illustrated) with a 5½-in. column, is available as

an accessory. Mounted on either the long or short column, the nibbling shear may be swiveled in a full circle. A locking screw is provided for locking the shear in any desired position on the column.

Beverly Shear Mfg. Co., 3001 W. 111th St., Chicago, Ill. **T-6-3**

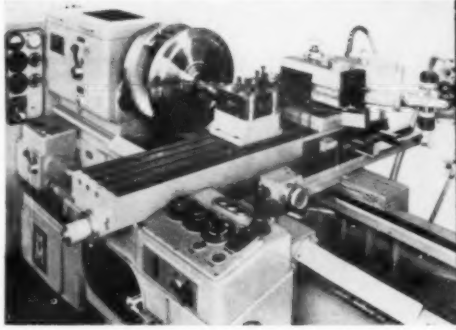
Lathe

Spindle revolutions in the Electromatic production lathe are automatically controlled by tool travel. Consequently, constant cutting speed can be maintained accurately even on copy profiling jobs with varying contours.

Constant cutting speed of the lathe made by Max Muller of Hanover, retains constant metal removal within a diameter ratio of 7:1. Uniform turned surface finish over the entire diameter range of the part is assured.

Desired cutting speed is set on a preselector dial, an electronic control that keeps cutting speed constant by stepless regulation of spindle revolutions. Switch-over from constant cutting speed to constant spindle revolutions can be made at any time. Cutting speed or spindle revolution can be selected while the machine is operating.

The machine includes eight 7:1 speed groups with cutting speeds ranging from 20 ft/min to 1800 ft/min. For production turning of workpieces with wide variations in diameter, the machine will operate alternately with either constant cutting speed or constant spindle revo-



lutions. Features of the machine include independent feeding front and rear tool slides on saddle, automatic feeding of upper tool slides, special hydraulic copying device.

Cosa Corp., 405 Lexington Ave., New York 17, N. Y. **T-6-4**

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Multiple Gage

This precision roundness, concentricity and squareness gage, designated the Indi-Ron, consists of a rotating table mounted on a precision spindle with one or more Indi-Ac electronic indicators scanning the part. Measurements are plotted on a polar coordinate chart recorder synchronized with the rotation

of the spindle. Error caused by spindle runout is less than three millionths of an inch.

By rotating the part instead of the gage head, it is possible to refer the concentricity and roundness of several diameters to each other simultaneously and with high accuracy. Roundness and profile characteristics of balls, rollers, bearing races, cylinders, gages, shafts from 1/16 to 6 in. in diameter can be determined and permanently recorded in a few minutes.

The entire instrument is contained in a

desk size console. Deviations from true roundness can be read either on the meter or permanently recorded at any of three magnifications—400, 2000 or 10,000.

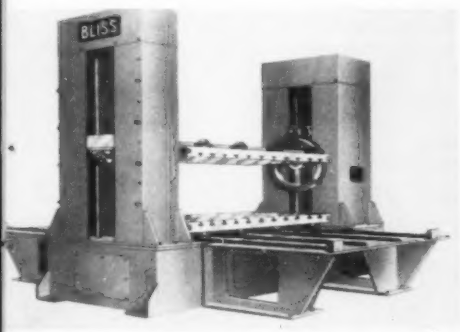
The table mounted on the spindle can be rotated manually or under power at 4 rpm.

Cleveland Instrument Co., Inc., 735 Carnegie Ave., Cleveland 15, Ohio.
T-6-5

Die Handling Machine

A die handling machine that safely and quickly manipulates dies in press room or die shop can be used either to turn over a die set or to open a set for maintenance, without danger of damaging the dies.

Wheel-mounted platens, both with JIC T-slots, are raised and rolled over by



the powered screw lift and turnover drive in the housings.

Open-top construction of the die handling machine permits removal of a half die by crane at any point in the operation.

E. W. Bliss Co., 1375 Raff Rd. S. E., Canton 10, Ohio. **T-6-6**

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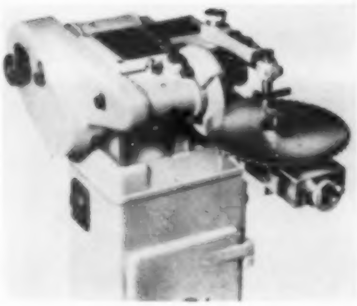
Saw Blade Grinder

All kinds of metal-cutting saw blades can be sharpened with Tempo saw blade grinding machine Models AS1, AS2, AS3, and AS4. By using a different attachment, band saw blades also can be resharpened.

Grinding operation of the machine, which runs automatically, does not depend on shape of the grinding wheel. The machine generates the tooth form, grinding the face as well as the back of the tooth. Adjustment by shift lever controls grinding straight or curved teeth. Rake and clearance angles also are adjustable. The tool also can be adjusted to grind only the land, as on



metal slitting saws, or to grind the face on form tool cutters.

Maximum index speed is 150 teeth per minute.

An attachment for resharpening power hacksaw blades also is available.

Cawi Machine Co., Inc., 34 Exchange Place, Jersey City 2, N. J. **T-6-7**

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Tool Wear Indicator

Constant visual reading of the amount of wear occuring while a tool is in operation is provided by a Tool-Gard indicator. Incorporated in the device is a Load-meter which shows machine tool overload conditions, preventing damage to the machine, tool or workpiece.

It will maintain accuracy for partial as well as full loads and will withstand starting surge currents while utilizing full range of the meter. The device also will compensate for line voltage changes and voltage transients thus avoiding possibility of inaccurate readings due to outside sources rather than machine load.

Futurmill, Inc., 6360 Highland Rd., Pontiac, Mich. **T-6-8**

Drill Unit

An improved Model-A Drillmaster is stronger than previous units. It has stress proof gears, heavier spindle shaft and positive adjustment. When inserted in conventional drill press chuck, the tool provides a 4:1 ratio for turning small drills at extremely high speeds. It uses standard chuck drills from 5/32

to No. 80. A 1/2-in. shank fits any standard 1/2-in. chuck.

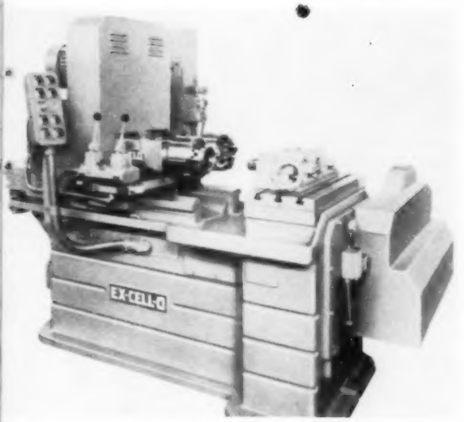
It is equally effective for ferrous and nonferrous materials as well as plastics and similar materials.

Dirzius Machine Shop, 1423-25 S. 52nd Ave., Cicero 50, Ill. **T-6-9**

Cam Boring Machine

A two spindle, Style 312 cam boring machine performs similar operations on two parts simultaneously. Work includes precision facing, chamfering, turning, boring and two position grooving on steel components more than 5 in. in diameter. Critical dimensions are held to close limits.

On the cross slide two sets of tools, with four tools in each set, engage the parts during the machining cycle. The first tool faces the front surface, chamfers the outside edge and turns the



outside diameter. The second tool bores the inside diameter, holding limits of ± 0.001 in. The third and fourth tools plunge the grooves.

Three-jaw, air-operated chucks are used and output is as high as 140 parts per hour.

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich. **T-6-10**

Drafting Table

This adjustable drafting table has an all steel top, as alternate equipment to the standard wood top, that is covered with Jaspe green linoleum which gives resilience for drawing purposes. The top is unaffected by changes in humidity or temperature.

The table is designed to give additional top height of 4 in. in 2-in. steps. Minimum height adjustment is $36\frac{1}{2}$ to $45\frac{1}{2}$ in.; maximum is $40\frac{1}{2}$ to $49\frac{1}{2}$ in.

There also is provision for immediate and easy adjustment to counterbalance

added weight when lights, drafting machines or straightedges are attached to the table top. A foot lever release brake provides height adjustment. Finger-tip action governs tilt positioning of the top.

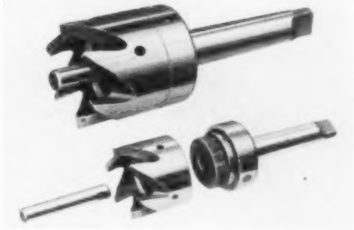
Among possible drawer and shelf combinations is a roll file for convenient filing of drawings 30 in. wide.

The Mayline Co., 619 N. Commerce St., Sheboygan, Wis. T-6-7

Hole Making Tool

Operating similarly to a conventional hole saw, the high-production Hole-Mill produces deep holes in flat, thick plate, or on curved cylindrical pieces. It can mill through-holes in stock as thick as $\frac{3}{4}$ in. in some tool sizes. The fast-cutting tool uses automatic feeds on various machines, goes completely through stock in one pass without clearing chips and can be used on alloy, as well as low carbon steels. It can be resharpened as required.

Due to the shape of teeth and special chamfer on their sides, chips are forced up and outwardly. Unusually deep tooth-form leaves ample opening on sides to eject chips. Number of teeth is selected on various Hole-Mill sizes



to assure maximum tooth strength and can be modified for specific material applications.

The tool is made from M3 type high-speed steel. The cutter itself is replaceable and threads onto a separate arbor which is equipped with a removable, pin type pilot. Step pilots or stub

drills also can be used. Each arbor accommodates several mill sizes and is available in all standard tapers and straight shanks.

Available covering a range of hole sizes from 1 to 4 in., other sizes to order, they can be used in all common machine tools, and because they are piloted, can be successfully used on portable equipment.

Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif.

T-6-11

Direct Reading Micrometer

Measurements from 0 to 1 in. by ten-thousandths of an inch can be made with this direct reading micrometer. Clear plastic windows show numbers indicating thousandths, in units of five-thousandths. Readings in ten-thousandths are made from easily-read vender graduations; five ten-thousandths are taken from the thimble. Jet-black graduations on dull chrome finish facilitates

reading. Graduations on the nonrevolving sleeves are flush with graduations on the revolving thimble; thus there is no danger of parallax and true readings are assured.

The lever action floating clamping arrangement allows easy, positive clamping and does not disturb spindle alignment. The micrometer, which can be used by unskilled personnel, is easily adjusted for surface wear or zero setting.

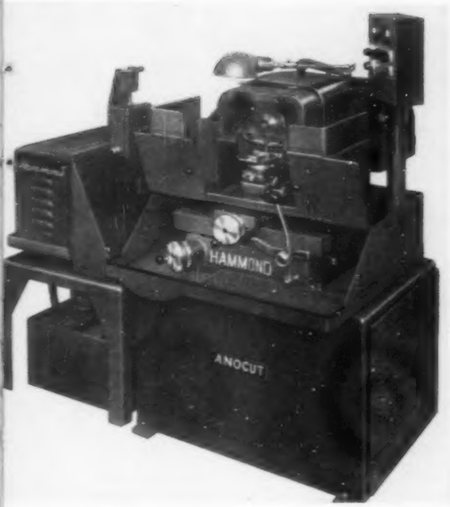
Brown & Sharpe Mfg. Co., Providence, R. I.

T-6-12

Grinder

Model CME-6 electrolytic double end chip breaker and cup wheel grinder for carbide tools is built with a 150-amp Anocut power pack in the base to provide a compact electrolytic grinding package.

The main drive of the medium duty unit is a $\frac{3}{4}$ hp motor-on-spindle grinding head and has precision bearings. Complete spindle assembly is dynamically balanced for smooth operation. The spindle is insulated from the machine and the power pickup is built



inside the motor. Grinding head is mounted on a large protected column which is aligned true with cam rollers in recessed ways. The table on the chip breaker, which side travels on ball bearing ways, has an 8 in. stroke.

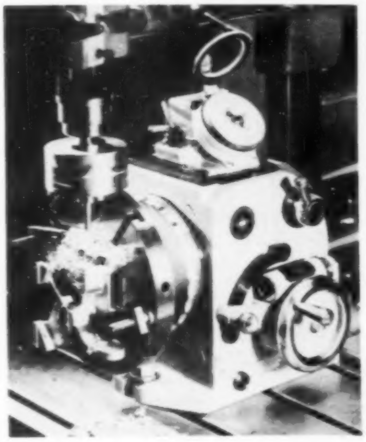
Mist and fog are controlled by proper hooding of both ends of the machine and are drawn away by a MistKolector, which is included with the machine.

Hammond Machinery Builders, Inc., 1661 Douglas Ave., Kalamazoo, Mich.

T-6-13

Dividing Head

Indexing accuracy of better than ten seconds is built into the OPL dividing head, and points may be relocated and reset as many times as desired to the



same accuracy. Direction of spindle rotation can be reversed at any time during indexing operation without error.

The direct reading method employs a graduated glass drum which trans-

mits light to produce a bright image. Greatly magnified graduations are subdivided so that readings to $2\frac{1}{2}$ seconds can be obtained directly.

Easy to operate and adaptable to many uses in manufacturing and inspection, the dividing head spindle can be tilted for operation at any angle from −5 to +90 deg. The angle of tilt is controlled by a vernier scale reading to one minute.

F. T. Griswold Mfg. Co., 315 W. Lancaster Ave., Wayne, Pa. **T-6-14**

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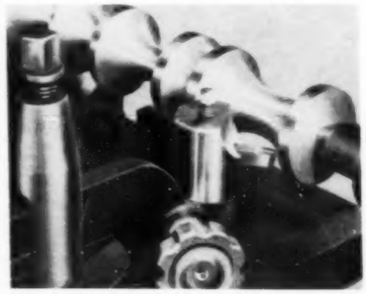
Radius Tool

A series of precision radius tools for 9 to 13-in. bench, floor and engine lathes include: No. 5 convex for cutting a $\frac{1}{4}$ to $\frac{13}{16}$-in. radius ($1\frac{5}{8}$-diam ball); No. 6 concave for cutting $\frac{3}{8}$ to 1 in. radius. Shanks are $\frac{3}{8}$ × 1 x 4 in. long.

Shank and body of the tool is a one piece steel casting enclosing bearings



and gears. Design is such as to avoid strain from worm and worm gear and to allow fairly heavy cuts without damage to the tool. There is no chatter during cutting of any radii.

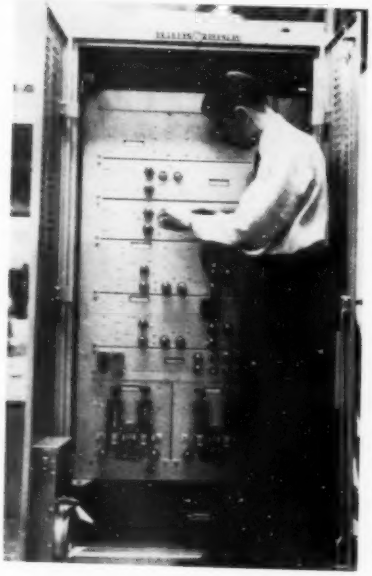
C. B. Teeter, 4470 Oakenwald Ave., Chicago 15, Ill. **T-6-15**

Numerical Control Package

Pre-engineered two-motion numerical positioning control package units designated Mark II, can be applied to any machine requiring point-to-point positioning of linear or rotary motions.

Motors, operator's control, position pickup devices, and tape reader are included in the package. Provisions have been made for control of auxiliary functions from punched tape by addition of necessary electrical devices.

The unit offers positioning speeds up to 60 ipm. The control provides for individual or simultaneous linear and rotary positioning and has an electrical accuracy of ± 0.0005 in. at travel lengths up to 99.99 in. For length of



travel up to 399.99 in., electrical accuracies of ± 0.005 in. can be obtained.

Mark II operates from numerical data stored in standard eight-channel, one-inch-wide punched tape and/or manually set decade switches, and is capable of both semiautomatic and fully automatic operation. Servodrives up to 3/4 hp maximum are controlled by a special Thymotrol adjustable speed drive. For applications requiring servo drives greater than 3/4 hp, the basic Mark II can be used with amplidynes and larger motors.

General Electric Co., Schenectady 5, N. Y. **T-6-16**

Belt Grinder

This conveyor type abrasive belt machine, Model 680-6, permits six grinding operations in a single conveyorized pass. Designed for high-volume flat surfacing of ferrous and nonferrous materials, the machine is equipped with six individually-adjustable grinding heads. By using a series of progressively finer grit abrasive belts, unmachined parts can be rough-ground, precision-sized and machined to a fine finish in one continuous operation. For parts requiring rapid but exceptionally heavy stock removal, identical belts can be used on each grinding head to multiply production rates.

Maximum piece capacity is 5 in. high, 5½ in. wide, any length. Size of machine's conveyor belt is 7 in. wide by 268 in. long. Abrasive belt size is 6 x 80 in., and abrasive belt speed is 5500 fpm. Grinding heads are powered with 7½ hp drive units. Models also are available with 8, 10 and 12-in. wide abrasive belts, with corresponding in-

creases in workpiece capacity. Quick manual adjustment of conveyor belt speed is obtainable for settings of from 2 to 25 fpm.

Engelberg Huller Co., 831 W. Fayette St., Syracuse 4, N. Y. **T-6-17**

Impregnation Equipment

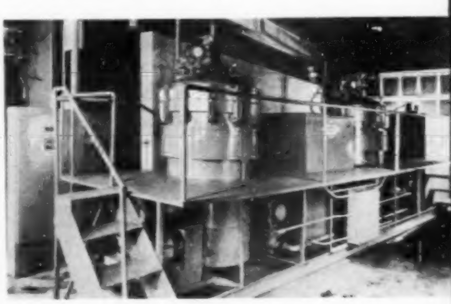
Twin-autoclave impregnation units, with fully automatic control for maximum operation safety, are designed for economical batch impregnation of pressure castings of all kinds. The package machines can be used with either plastics or metal oxide type sealing materials.

This Model P-200 series consists basically of a large sealant supply tank, a rim-spray rinsing tank and two autoclave type sealing tanks. Each unit has dual vacuum system, heating elements, motor-driven agitator and fully automatic electronic controls. Integral platform construction provides waisthigh access to all controls and operating components.

In the standard design, both autoclaves are supplied by the same sealant tank. A special modification, having a separate supply tank for each sealing tank, is also available for applications requiring double impregnation processing.

It can be installed above the floor or in a pit. Because of integral construction, the machine can be readily moved and installed as a complete unit, without disturbing individual components. The standard Model P-200 is 26 ft long, 6 ft wide and 9 ft high. Electronic controls are mounted in a separate enclosed control panel.

For use with metal oxide type sealing materials, three types of sealant



supply tank heating arrangements are available—gas (standard), electric or steam. Where plastic sealing material is to be used, the equipment package is provided with an unheated tank or an insulated refrigerator type tank.

The twin vacuum pumps provided are of the continuous operating steady 29.9-in. Hg type, driven by a 1-hp, 220-440-v, 60 cycle, 3-phase electric motor. The sealant agitator is mounted to the supply tank cover.

Prenco Mfg. Corp., 507 E. 10 Mile Rd., Hazel Park, Mich. **T-6-18**

Radial Drill

Maneuverable, 3-ft radial drill has hardened way inserts on the head and arm, which are easily replaceable. A widened dovetail way on the arm triples the bearing surface for continued accuracy. A single lever arm clamp locks arm to column.

Quick action clutching speeds drill operation and positive jaw type clutch can never slip. Cam lift head clamp insures squareness of head to widened dovetail on arm, while a traverse wheel in front permits arm and traversing head to be swung with one movement to speed hole lineup. Tapping control allows fast tapping and minimizes tap breakage. The $3^3/_8$-in. diameter boring type drill is hardened and lap-fitted to head, providing accuracy for jigless spacer-table boring. Built-in elevation motor reduces over-all height by 7 in. Feed gears are enclosed in an oil bath for constant lubrication. Sixteen spindle speeds are

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A-6-269-4—Turret Lathe Drive—*Acme Industrial Co.* Hydrive literature describes conversion of hand-operated turret lathe into automatic. (Page 269)

A-6-206—Chucks—*Alina Corp.* Literature and complete catalog on Alina Scroll Chuck available. (Page 206)

A-6-62—Barrel Finishing Equipment—*Almco, Queen Products, Inc.* 52-page book on precision barrel finishing processes contains facts, photos, data and cost comparison charts. (Page 62)

A-6-255-1—Metal Cutting Machine—*American Pullmax Co., Inc.* Free catalog of metalworking ideas describes various operations on Pullmax Machines. (Page 255)

A-6-2—Lathes—*American Tool Works Co., Inc.* Advantages offered by the new DeLuxe Model Pacemaker Lathe described in bulletin No. 124. (Page 2)

A-6-163-1—Broaches—*Apex Broach Co., Inc.* Breaches, holders, and fixtures described in Apex Brochure. (Page 163)

A-6-166—Hacksaw Blades—*Armstrong-Blum Mfg. Co.* New catalog on Marvel metal cutting saws. (Page 166)

A-6-163-2—Tap Grinder—*Edward Blake Co., Inc.* Tap Sharpening Machines made by Blake described in bulletins. (Page 163)

A-6-66—Grinding Wheels—*The Blanchard Machine Co.* Free copies of "Blanchard Abrasive Wheels and Segments" and "The Art of Blanchard Surface Grinding." (Page 66)

A-6-225—Gear Reducton Units—*Boston Gear Works.* New catalog OP-1 lists complete data on Optimount helical geared reductors and ratiomotors. (Page 225)

A-6-173—Milling Cutters—*Cutting Tool Division, Brown & Sharpe Mfg. Co.* New Nelco catalog shows over 700 cost-cutting tools. (Page 173)

A-6-238-3—Vise—*Cardinal Machine Co.* Uses of Speedvise and complete description available in new catalog. (Page 238)

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A-6-210—Rivets—*Chicago Rivet & Machine Co.* Rivet catalog describes 1388 standard tubular and split rivets, 26 automatic rivet setters. (Page 210)

A-6-11—Milling Machine Arbor-Nose—*Cincinnati Milling Machine Co.* Arbor-Loc spindle nose described in publication No. M-2016. (Page 11)

A-6-252-2—Height Gage—*Cleveland Instrument Co.* Free bulletin describes the Indi-Ac indicating height gage, and its protection from accidental blows. (Page 252)

A-6-56—Die-Sinking Machine—*Cosa Corp.* Deckel Universal Pantograph Die-Sinking Machines are described in free catalog. (Page 56)

A-6-29—Boring Mill—*DeVlieg Machine Co., Jigmill Division.* DeVlieg Spiramatic Jigmils are described in detail in new catalog. (Pages 28-29)

A-6-65—Hydraulic Valves—*Dukes Co.* Complete new catalog of Dukes hydraulic equipment available. (Page 65)

A-6-227—Optical Comparators—*Eastman Kodak Co.* Details on how optical gaging can save money and time in your operation described in booklet "Kodak Contour Projectors." (Page 227)

A-6-185—Milling Machine—*Famco Machine Co.* Free catalog describes various Famco milling machines. (Page 185)

A-6-259—Drilling Machines—*Foote-Burt Co.* Circular No. 508A gives complete information on sensitive drilling machines by Footburt. (Page 259)

A-6-204—Microscopes—*Gaertner Scientific Corp.* Bulletin 161-54 shows applications, models, specifications of various microscopes. (Page 204)

A-6-174—Hydraulic Cylinders—*Galland-Henning Nopak Division.* Catalog No. 103 contains complete data and dimensions on Nopak valves and cylinders. (Page 174)

A-6-237—Portable Screwdrivers—*Gardner-Denver Co.* 40-page booklet gives complete information about Keller screwdrivers and nut setters. (Page 237)

A-6-10—Lathes—*Gisholt Machine Co.* Advance data on Gisholt new Masterline No. 12 automatic production lathe described in Form 1178. (Page 10)

A-6-60—Silver Alloy Brazing—*Handy & Harman.* Bulletin No. 20 gives information on design methods and economies of silver alloy brazing. (Page 60)

A-6-5—Lathes—*Hardinge Brothers, Inc.* Model HLV 10" lathe described in Bulletin HLV. (Page 5)

A-6-205—Progressive Dies—*B. Jahn Mfg. Co.* Brochure contains 20-pages of case histories using Jahn dies. (Page 205)

A-6-224-1—Threading Machines—*Lees-Bradner Co.* Free Cri-Dan brochure describes complete line of threaders. (Page 224)

A-6-239—Welding Equipment—*The Lincoln Electric Co.* Advantages of the inner-shield process described in Bulletin 5301.1. (Page 239)

A-6-49—Hydraulic Valves—*Logansport Machine Co., Inc.* Hydraulic valve design made easier with free Calculator. (Page 49)

A-6-269-1—Magnetic Sockets—*Magna-Driver Corp.* Manual available on complete line of Magna-Tip magnetic bit holders, finders, sockets and hand screwdrivers. (Page 269)

A-6-40—Static Controls—*Magnetics, Inc., Control Division.* Control reactors and their application described in free bulletin. (Page 40)

A-6-244-2—Tool Holders—*Marcellus Mfg. Co.* Complete sizes and specifications for easier tool planning available in new catalog. (Page 244)

A-6-262-1—Milling Cutters—*W. F. Meyers Co., Inc.* Bulletin No. 52 describes the facilities of W. F. Meyers Company for custom production of cutters. (Page 262)

**A-6-177 — Profilometer — ***Micrometrical Mfg. Co.* Free illustrated bulletin gives details and describes cost-saving applications of the Profilometer. (Page 177)

A-6-253—Cutting Fluids—*Harry Miller Corp.* Free booklet describes results users have obtained with Immunol odorless solvent. (Page 253)

A-6-240—Tooling Compound—*Minnesota Mining & Mfg. Co.* Tooling compound No. 113 described in new literature. (Page 240)

A-6-155—Aluminum Castings—*Monarch Aluminum Mfg. Co.* Free brochure describes manufacturing achievements in molten aluminum. (Page 155)

A-6-269-3—Tools—*Montgomery & Co., Inc.* New 1958 catalog describes 92 time savers for tool makers. (Page 269)

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A-6-165—Cleaning Compound—*Oakite Products, Inc.* 14-page booklet called "Here's the best shortcut in the field of electroplating" describes use of Oakite Rustripper. (Page 165)

A-6-68—Induction Heating—*The Ohio Crankshaft Co.* Free booklet "Typical Results of TOCCO Induction Brazing and Soldering." (Page 68)

A-6-158—Cutter Grinder—*Olkon Corp., Machine Tool Division.* Detailed information and prices on Oerlikon FS21 Form and Cutter Grinder available (Page 158)

A-6-202—Boring Machine—*Olofsson Corp.* Free literature describes applications of a 30-012 Olofsson precision boring Machine. (Page 202)

A-6-176—Coated Plastic Charts—*Optical Gaging Products, Inc.* Information available on the OGP Fast-Line Coated Plastic for charting. (Page 176)

A-6-154—Hydraulic Cylinders—*Ortman-Miller Machine Co.* New catalogs numbers 107 and 108 give detailed information on air and hydraulic cylinders. (Page 154)

A-6-258-3—Tool Materials—*Parkwood Laminates, Inc.* Technical Bulletin shows how to reduce tool fabrication time and improve quality of stamped or rolled shapes. (Page 258)

A-6-48—Hydraulic Benders—*Pines Eng. Co., Inc.* Case studies on production bending described in free data sheets. (Page 48)

A-6-234—Aluminum—*Pioneer Aluminum, Inc.* Applications of Pioneer 921-T cast aluminum tooling plate described in issues of Tool Talk. (Page 234)

A-6-67—Die Sets—*The Producto Machine Co.* New catalog No. 11 gives complete data on Producto die sets. "Die Set Digest" gives tips for designers and builders. (Page 67)

A-6-226—Turning Tools—*R and L Tools.* New catalog describes complete line of cutting tools. (Page 226)

A-6-189—Thread Rolls—*Reed Rolled Thread Die Co.* Thread Rolling Attachment Bulletin B-2 gives helpful information on thread and form rolling. (Page 189)

A-6-207—Punches and Dies—*Ring Punch & Die, Inc.* Illustrated catalog 105 describes complete line of Ring punches and dies. (Page 207)

A-6-195—Sine Plates—*Omer E. Robbins Co.* Catalog shows complete range of Robbins' sine plates. (Page 195)

A-6-184—Clutches—*Rockford Clutch Div., Borg-Warner.* Typical installations of Rockford Clutches and power take-offs with diagrams. (Page 184)

A-6-244-3—Optical Tooling—*Geo. Scherr Optical, Inc.* Illustrated folder (code GIUKT) describes Opto tooling autocollimator. (Page 244)

A-6-171—Recessing Tools—*Scully-Jones & Co.* Bulletin 10-50 describes typical recessing jobs and includes check list for investigating possible applications. (Page 171)

A-6-30—Centering Machine—*Seneca Falls Machine Co.* Bulletin CS-47 describes advantages of Model "CS" Centering Machine. (Page 30)

A-6-63—Automation Systems—*Sheffield Corp.* Basic data on automation systems circuits and equipment described in bulletin AU 57-12. (Page 63)

A-6-255-2—Lathes—*Sheldon Machine Co.* New catalog describes Sheldon variable speed precision lathes. (Page 255)

A-6-8—Grinding Wheels—*Simonds Abrasive Co.* Bulletin ESA 272 contains details and engineering specifications on grinding wheel. (Page 8)

A-6-262-2—Self-Aligning Bearing—*Southwest Products Co.* Revised engineering manual describes complete line of Monoball self-aligning bearing. (Page 262)

A-6-249—Dial Bore Gages—*Standard Gage Co., Inc.* Product bulletin 58-1 available on right angle dial bore gages. (Page 249)

A-6-54—Cap Screws—*Standard Pressed Steel Co., Unbrako Socket Screw Division* Technical data and specifications on Unbrako socket head cap screws is now available in Bulletin 2406. (Page 54)

A-6-156—Transfer Machines—*Sundstrand Machine Tool Co.* Examples of Sundstrand cost-cutting transfer lines discussed in Bulletin 792. (Page 156)

A-6-192—Die Sets—*Superior Steel Products Corp.* Free 24-page catalog on Superior die sets and supplies. (Page 192)

A-6-182—Air Hoist—*Thor Power Tool Co.* Complete details on portable air hoists in Bulletin No. JE-2367. (Page 182)

A-6-266-2—Balancing Machine—*Tinius Olsen Testing Machine Co.* Bulletin 56 describes Rava Electro-dynamic balancing machines. (Page 266)

A-6-186—Hydraulic Cylinders—*Tomkins-Johnson Co.* The new T-J Spacemaker high pressure hydraulic cylinder described in bulletin No. HSM-5-58. (Page 186)

A-6-190—Dust Collector—*Torit Mfg. Co.* New 28-page handbook describes dust control and full details on Torit Unit (Page 190)

A-6-12—Tool Steel—*Uddeholm Co. of America, Inc.* Tool steel stock list No. 12 now available. (Page 12)

A-6-18—Multi-Slide Machines—*U. S. Tool Co., Inc.* Copies of Multi-Slide bulletin No. 15. (Page 18)

A-6-42—Tooling Accessories—*Universal Eng. Co.* 98-page catalog describes standard chucks, tool holders, drill bushings and other products. (Page 42)

A-6-200-1—Tube End-Forming Machines—*The Vaill Eng. Co.* Bulletin T-1 shows Vaill tube forming machines for various operations. (Page 200)

A-6-152—Carbide Tools—*Vascoloy-Ramet Corp.* New booklet contains complete information on all V-R products. (Page 152)

A-6-230-1—Abrasive Cut Machine—*Wallace Supplies Mfg. Co.* Free 44-page book on Wallace cutting machines. (Page 230)

A-6-244-4—Bending Manual—*Wallace Supplies Mfg. Co.* Free 36-page manual shows use of bending equipment in users plant. (Page 244)

A-6-252-3—Band Saws—*Wells Mfg. Corp.* Bulletin 235-H describes Wells Model 49A metal-cutting band saw. (Page 252)

A-6-224-3—Clamps—*West Point Mfg. Co.* Toggle clamps and fixture components described in free catalog. (Page 224)

A-6-214-1—Perforating Dies—*S. B. Whistler & Sons, Inc.* Complete details on Whistler magnetic dies in catalog M-1955. (Page 214)

A-6-258-1—Motion Picture Cameras—*Wollensak Optical Co.* Free bulletin and detailed information available on WF-17 Fastax combined motion picture and oscillographic camera. (Page 258)

A-6-187-1—Tube Mills—*The Yoder Co.* Fully illustrated 88-page Yoder tube mill book describes advantages of operating Yoder mill. (Page 187)

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available in uniform steps, with four power feeds geared to the spindle speeds. A drill ejector in the spindle facilitates tool changes; raising and lowering the arm is by push buttons.

A floor level base model affords 62-in. capacity under the spindle, and a double-end base model, by swinging the arm 180 degrees, also provides 62-in. capacity under the spindle.

Veet Industries, 25753 Groesbeck Hwy., E. Detroit, Mich. **T-6-19**

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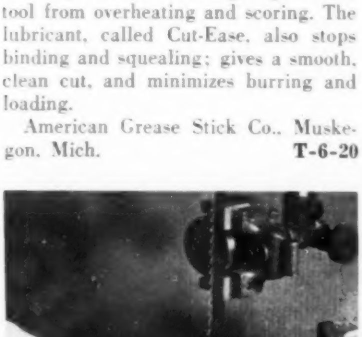
Stick Lubricant

Stainless stick lubricant for cutting and sawing nonferrous metals and materials is applied like a crayon directly to the cutting edge of the tool. Upon application it changes from a solid to a thin, adhesive coating, with lubricating and film strength properties which protect the cutting edge of the tool from overheating and scoring. The lubricant, called Cut-Ease, also stops binding and squealing; gives a smooth, clean cut, and minimizes burring and loading.

American Grease Stick Co., Muskegon, Mich. **T-6-20**



Abrasive Cutting Unit

An oscillating abrasive cutting machine, called the See-Saw, can travel over a prescribed distance either steadily or intermittently at any desirable frequency of reciprocation.

The machine is powered by three separate motors. One rotates the cutting wheel and is always functioning during a cut. A second motor powers the forward and back travel of the cutting head. A push-button control on the right handle controls this motor. A third motor supplies more than 35 gallons of cutting compound to the cutting area. This motor is controlled by a push button on the left handle.

Pressure down (or cutting pressure) is directed by both hands of the operator.

The machine can cut anywhere in a 9 x 18-in. area. It will cut 3 x 18-in. plate, 18 in. channel, 8 in. XH pipe,

8 in. round or square bar, or 8 x 8 x 1 in. angles or any comparable sections.

It also can cut squares or miters. It can cut wet with rubber bonded wheels, or can cut dry with resinoid bonded wheels. It has a 26-in. diameter wheel and a 20 hp main motor.

Wallace Supplies Mfg. Co., 1304 Diversey Pkwy., Chicago 14, Ill. **T-6-21**

USE READER SERVICE CARD ON PAGE 267 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Thimble Micrometer

The convertible thimble of this finger tip controlled micrometer permits the tool to be used either as a "friction" or "fixed" type. Used conventionally, the operator depends on sense of feel for measurements; to make it the slip or friction type, a slight rotation of the nut provides a uniform measuring pressure.

Graduations on the barrel are at an oblique angle to facilitate positive reading regardless of thimble position. The lever-type floating lock allows "miking" and locking with one hand, as it requires only a flick of the lever.

The tool has one-piece stainless steel spindle and screw with hardened and

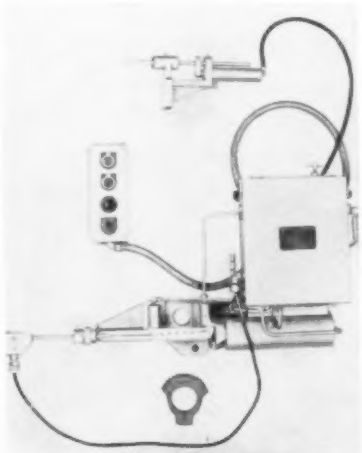
ground threads, carbide measuring faces and one-piece frame and barrel. Simple longitudinal adjustment accommodates wear of measuring faces.

This micrometer, with a range of 0 to 1 in., is graduated in ten-thousandths of an inch.

Brown & Sharpe Mfg. Co., Providence, R. I. **T-6-22**

Grinding Attachment

Automatic infeed grinding attachment, called Feedcision, incorporates an air-operated automatic ejector and push-button station. It is attached with five



cap screws which mount in tapped holes that are standard on all No. 2 Cincinnati centerless grinders.

The operator merely drops the workpiece between the wheels and presses the start button. Feed control infeed and spark out timing are automatically adjusted.

Modern Devices, Box 249 TE, Libertyville, Ill. **T-6-23**

General Purpose Carbide

A general purpose carbide, called NewPro, is available in grade S-35 for cutting steel, and C-35 for cutting cast iron and nonferrous materials. These correspond respectively to Carbide Industry Code C-6 and C-2.

The low cost carbide is stocked in standard sizes and styles of triangular and square Throway type inserts for mechanical tool holders, and in triangular and square Throway milling cutting blades. Rough molded blanks of all shapes and sizes, standard and special, also can be furnished.

Newcomer Products, Inc. Latrobe Pa. **T-6-24**

Turret Lathe

Designed for secondary operations and production jobs, this high-speed turret lathe affords 13-in. swing over the bed ways; 1⅛-in. collet capacity makes the lathe suitable for both chucking and precision collet work. A

six-station ram turret accommodates up to 1-in. shank turret tools.

Spindle speeds from 40 to 2000 rpm are selected automatically by fast-slow push-button controls. Actual spindle speeds are read from a built-in tachometer in the headstock.

A heavy-duty cross-slide with front and rear tool blocks has screw-operated wedges for easy height adjustment of cutting tools. T-slots in the slide

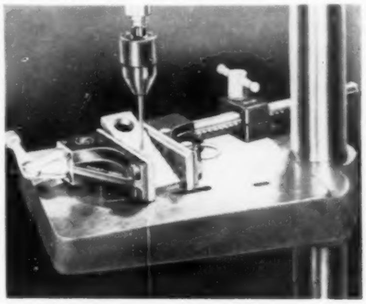
permit universal adjustment of both tool blocks.

Available production accessories include air-operated bar feeds, air-operated collet and chucking attachments, coolant systems, step chucks and closers, two-speed motors and controls.

Sheldon Machine Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill. **T-6-25**

Vise

The Float-Lock Instant-Change vise assures positive anchoring on drill press table. It floats and locks in any



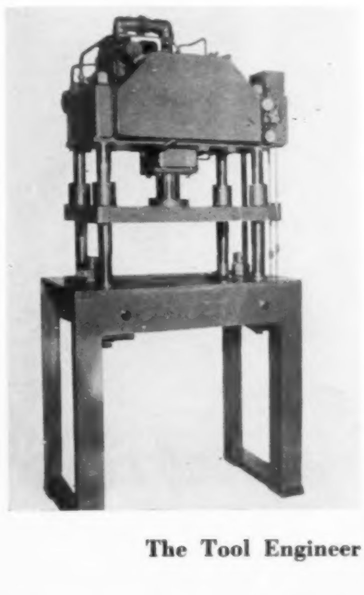
position; holds the work safely for accurate drilling and tapping.

AMF Tool Div., Bloomfield, N. J. **T-6-26**

Air-Hydraulic Trim Press

In this air-hydraulic press, the ram advances at speeds up to 1300 ipm under the influence of a built-in air accumulator which forces oil behind the closing ram through a specially designed poppet pilot valve. Shut height, position of stroke and length of stroke can be rapidly adjusted by means of set collars.

Model 25 is a 25-ton press with



stroke adjustable from zero to 12 in. Distance inside the tie bars is 17 x 33 in.; tie bar diameter is $2\frac{1}{2}$ in.; area of the lower platen, 31 x 40 in. Approach speed is from zero to 1300 ipm; return speed 550 ipm. Shut height ranges from $6\frac{1}{4}$ to $18\frac{1}{4}$ in. Pull-out tonnage is $4\frac{1}{2}$.

The press can be moved easily about the shop with a lift truck. All hydraulics are placed on the top crown beam. Base and head of the press are of crown welded construction 8 and 16 in. thick, respectively, to prevent deflection.

B & T Machinery Co., Holland, Mich.

T-6-27

Hardness Tester

This Burton Universal three-in-one portable hardness tester permits vertical, horizontal and inverted tests with accuracy comparble to laboratory machines. The English made instrument is entirely mechanical and records Rockwell A, B and C values independently. Precision mechanism of the instrument, which weighs less than three pounds, is capable of recording accurately the magnification ratio between actual movement of the diamond indentor and linear

travel of the indicator. Penetration depth of the indentor is less than 0.005 in. assuring mark-free testing of highly finished and polished surfaces. One sixteenth inch rounds, sheet steel in coils or bundles, irregular shapes and sizes can be tested in a matter of seconds. No anvil is required, and a set mechanism is built in to the instrument.

G. A. Peabody Industrial Co., 11310 McKinney Ave., Detroit 24, Mich.

T-6-28

Web Thinning Machine

Index arrangement of this web thinning machine thins out heavy webs correctly and accurately. Variation in the flute depth is corrected by bringing the chisel edge back into dead center. Positive or negative rake angles alongside the cutting edges can be ground for special applications.

The machine is also capable of

grinding an undercut alongside the cutting edge for producing rolling chips, especially on automatic screw machines where long chips cause trouble. Capacity is from 1/16 to 2 in. diameter.

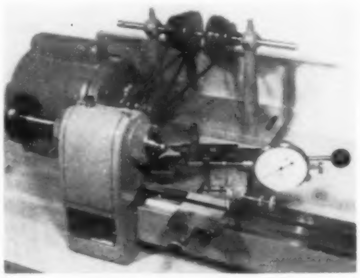
Distributed by Cawi Machine Co., Inc., 34 Exchange Pl., Jersey City 2, N. J. **T-6-29**

Radius Turning Attachment

Developed to turn concave and convex radii, this radius turning attachment can be used with the Model A lathe, which has a ½-in. capacity through the headstock, to turn a piece to any radius that is needed. An off center radius can be adjusted. By using a step chuck, a radius of up to ¾ in. in diameter can be turned.

An indicator is available, in either 0.001 or 0.0001 inch or in millimeters.

The lathe can be driven by a countershaft and motor from which 12 speeds



from 800 to 3000 rpm in steps of approximately 300 rpm, can be obtained. An adjustable speed drive can be used which provides seeds of from 400 to 4700 rpm. With an adjustable speed drive motor, the drive is below the bench and the belt can be changed without disassembling the headstock.

F. W. Derbyshire, Inc., Waltham 54, Mass. **T-6-30**

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Surface Measuring Machine

Waviness on symmetrical surfaces of rotation can be measured with this vertical Wavometer®. Equipment illustrated will handle ID's and OD's of surfaces up to 18 in. in diam and provides for angular adjustment of 30 deg above horizontal to 70 deg below. Operation requires no special skill or technical knowledge.

The machine gives meter reading of the rms average height of the waves in

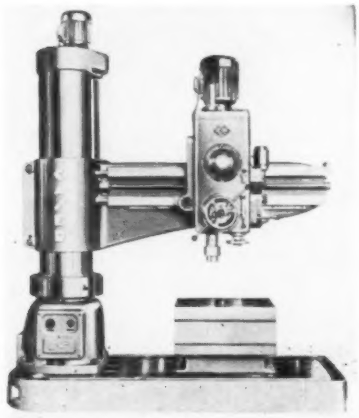
two wave-bands, directly in microinches. An oscilloscope also shows general shape and spacing of the waves in either wave-band. An amplifier transforms surface irregularities into sound to facilitate detection of deviations from the normal.

Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich. **T-6-31**

Radial Drill

Power arm elevation on the relatively inexpensive Caser model F25 radial drill is controlled by a single lever which locks the arm when lever is in neutral position. Roller-mounted head on arm is hand controlled while a single control starts, stops and reverses the spindle. While the machine is running on one operation, speed for the next can be preset on the direct-reading dial. The feed dial can be turned to a new setting while the machine is running and the tool is engaged. The feed-selector dial has a built-in feed and speed chart.

Model F25 has 2-ft 6-in. arm length, 8-in. column. Drilling capacity in steel is 1 in. and in cast iron is $\frac{3}{8}$ in. Spindle diameter at nose is $2\frac{3}{8}$ in. and spindle travel is 8 in. Spindle, with No. 3 Morse taper, has 8 speeds ranging from 205 to 2300 rpm, and 3 feeds. Spindle motor is two speed, $1\frac{3}{4}$-2 hp.



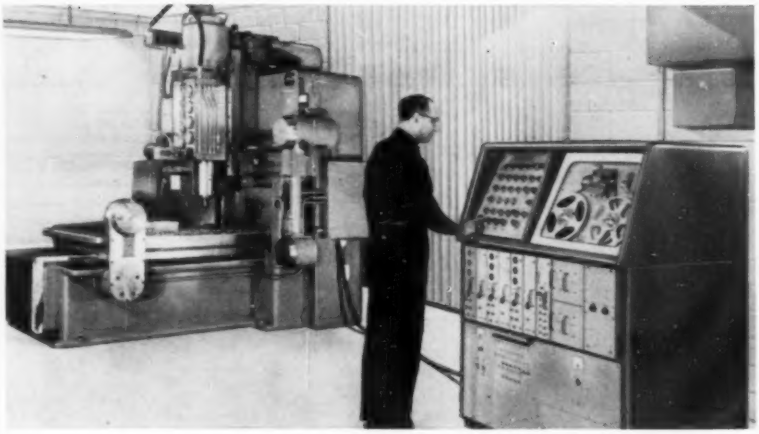
Vertical travel of arm and column is $23\frac{3}{16}$ in.; maximum distance from spindle nose to base, 46 in.; minimum distance spindle nose to base, $15\frac{3}{16}$ in. Head travel on arm is 23 in. Maximum distance from column OD to spindle center is 30 in.

Distributed by Maserati Corp. of America, 662 Main St., Westbury, L. I., N. Y. **T-6-32**

Numerical Control for Small Shops

This numerically controlled machine tool, suitable for job shop use by small plants, utilizes the Digimatic numerical control system. Relatively small in size, it offers high performance and simplicity of operation. Contoured parts can be programmed directly from blueprints by machine shop personnel.

The Digimatic control incorporates sturdy, high-power magnetic amplifiers. Use of an E.C.S. electronic interpolator



or "Director" makes it possible to cut smooth continuous circular contours and true circles.

The control unit occupies less than 12 sq ft of space, yet has full capability to run the 4 x 4 ft bed-type Model A-50 machine, including its heavy duty 30 hp spindle, in a full 3-axis capability, including lines and circles. Self-checking features and modular design packaging principles make the control console simple to use and maintain under tape control. Cutting speeds up to 100 ipm are available, with tolerances down to 0.001 in. The machine also is equipped with micro-dials for positioning and push buttons which enable the operator to use it as a conventional milling machine.

Using half-inch magnetic tape operating at a speed of only $7\frac{1}{2}$ ips, a full hour of machining can be accommodated on a 2400-ft roll of tape. The 30 hp spindle, with speeds adjustable from 20 to 3600 rpm, provides a wide range of control suitable for machining heat-treated steels as well as the softer metals and alloys such as aluminum and magnesium.

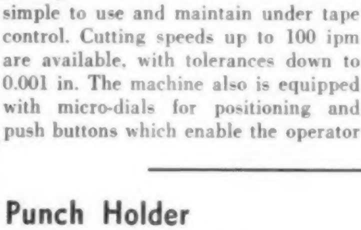
Electronic Control Systems, Div. of Stromberg-Carlson, 5415 York Ave., Los Angeles, Calif., or Morey Machinery Co., 387 Lafayette St., New York, N. Y. **T-6-33**

Punch Holder

With this punch holder for tool and diemakers there is no need for parallels and blocks. Self-centering and self-aligning, the holder is adjustable for punch shanks $\frac{3}{4}$ to 2 in. diam. Surfaces are ground parallel to 0.0005 in.

It is useful as a base for drilling and reaming, may be used on surface grinders to sharpen punches without removing them from the punch plate; may be used to make light milling cuts on punch sections without removing from the punch plate; or is useful as a bench vise to support punch plate while assembling and finishing punches.

Durant Tool Supply Co., 1-15 Thurbers Ave., Providence 5, R. I. **T-6-34**



Lapping Machine

A simple-to-operate 24-in. semiautomatic lapping machine can deliver flatness to less than 0.00011 in. and a surface finish as low as 1 microinch rms. Its fully automatic work cycle, includes application of the lapping compound. Adjustable speed drive from 16 to 76 rpm, allows selection of best lapping rate. Special designed magnetic truing rings maintain continuous plate flatness while the machine is in operation.

Designed primarily for lapping small parts in production lots, the machine also can accommodate any large casting or similar part that will fit in any one of the truing rings, which have a $8\frac{7}{8}$ in. ID. Small parts are placed inside the truing ring using masonite separators, where they are held in contact for a lapping by weight plates. These masonite separator plates can be cut, drilled or otherwise shaped to accommodate parts of any outline.

Almost any type of material can be successfully lapped on the machine, including alloys, which can be lapped in the hardened state, and nonferrous metals, plastic and ceramics. Selection

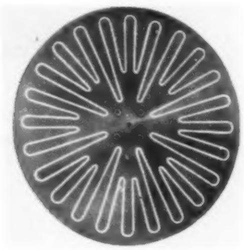
of the proper lapping compound and plate speed is all that is required to produce the right surface finish. Lapping compound is automatically supplied from a special tank which has a built-in agitator.

Taft-Peirce Mfg. Co., Woonsocket, R. I. **T-6-35**

Rotary Magnet

The Crow Foot electro rotary magnet has a radial pattern magnetic design, with as many radial lines as can be accommodated on the magnet face. The greater the number of radial lines, the greater the holding torque.

Although designed for grinding, Crow Foot rotaries are in successful operation holding jet engine parts for



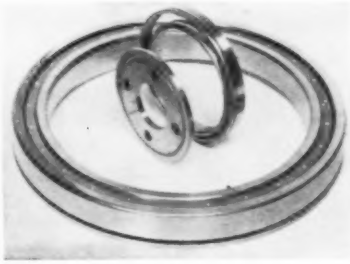
turning on lathes. On the same machine tools, some of the rotaries have been adapted for vacuum, so that on the same face, ferrous parts are held magnetically and nonferrous parts held with vacuum. Sizes range from 10 to 24 in. diameter.

Magnetic Holding Devices, 2034 E. 22nd St., Cleveland 15, Ohio. **T-6-36**

Bearings

Thin-section radial ball bearings are especially designed or built to specifications for bearing fabrication to avoid warpage. They are particularly useful where space and/or weight must be decreased.

The bearings can be fabricated from

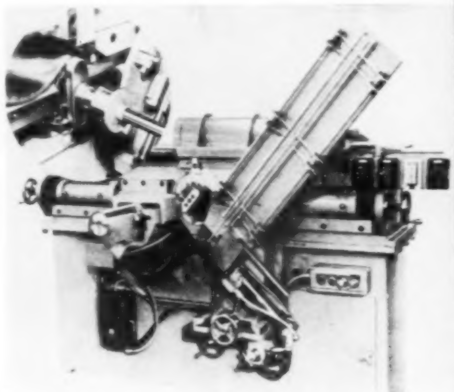


almost any type of bearing material including magnetic stainless steel, non-magnetic stainless steel, SAE 52-100, aluminum, bronze, K-Monel and ceramics. They can be either a full complement or retainer type. Typical examples of thin-section bearings have the following measurements: bore 110 mm, OD 140 mm, width 16 mm; a second has bore 30 mm, OD 42 mm, width 7 mm.

Ann Arbor Bearing and Mfg. Co., 815 Wildt St., Ann Arbor, Mich. **T-6-37**

Shell Trimmer

Model ST-4 sliding knife drawn shell trimmer can trim up to 800 shells per hour of any shape within a 6-in. diameter excepting those with extreme internal corners. Basically the sliding knife mates with a rotating universal bolster spindle holding the shell. There



is no possibility of any change in direction of force, and slicing action permits trimming to be done with low unit force.

Dayton Rogers Mfg. Co., 2826 13th Ave., S., Minneapolis, Minn. **T-6-38**

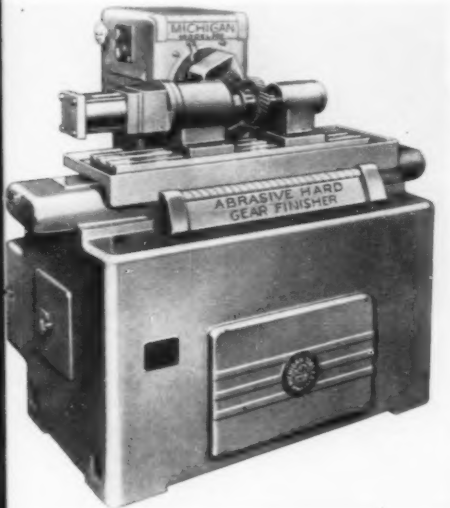
Gear Finishing Machine

Hardened gears up to 12-in diam can be economically finished to quiet-operating smoothness with abrasive throwaway tools without matching of gears in pairs. Tightened dimensional accuracy, surface finish and contact pattern, and materially reduced noise

characteristics are achieved with a gear-finishing machine which also permits salvaging of gears otherwise too noisy to meet desired standards. Smoothness and life characteristics of gears in service are also improved. The compact machine which requires 5 x $6\frac{1}{2}$ ft floor space is applicable to either high or low production.

Model 999 hard gear finisher utilizes throwaway tooling for crossed-axis finishing of hardener gear teeth to quickly clean up hard spur and helical gear teeth to improve the finish and sound characteristics of the gears. Average cycle time is little more than a minute.

The rotary abrasive-impregnated type finishing tool is of plastic abrasive (80 grit average) construction varying to



suit the application. The throwaway tool is supplied in a $9\frac{1}{4}$ in. diam size in face widths of 1 and $1\frac{1}{2}$ in. A crowning attachment, for finishing hard gears with especially high crowns, is optional.

The hard gear finishing method is adaptable to manual, semiautomatic or fully automatic loading. Finishing action of the tool cleans up small deviations in tooth form and lead. Any nicks and burrs are also removed at the same time. Rotating speed of the tools is adjustable to suit size of gear being finished.

The finishing-tool mount, on an adjustable head supported by precision bearings, is outboard mounted for easy tool change. Tool head settings are readily made from either a graduated scale or positive stops.

The machine is equipped with a reciprocating work table, speed-controlled by change gears.

Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. **T-6-39**

Tool Steel

A low alloy steel, known as LaBelle® HT is suitable for applications requiring unusual resistance to shock or impact such as shear blades, impact extrusion tools, cold heading dies and punches and coining and striking dies.

Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 22, Pa. **T-6-40**

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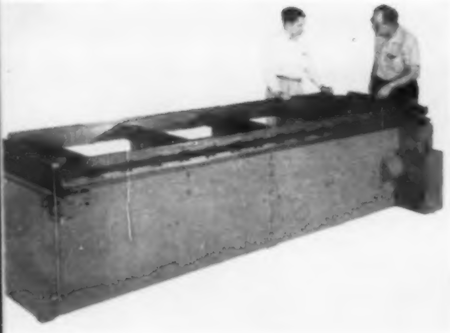
Indexing Chassis

A standardized chain indexing chassis, called the Automator, is available in two basic standard models. The OT series indexes parts carriers around a base frame; the OU series indexes parts carriers over and under a base frame.

The base frame requires minimum floor space; standard models are 41 in. wide and are built in increments of 6 ft in length to suit customer requirements; frame design provides firm and easy mounting of work stations.



Standard models offer indexes of $1\frac{1}{4}$ to $11\frac{1}{4}$ in. in length, and outputs up to 1500 indexes per hour.

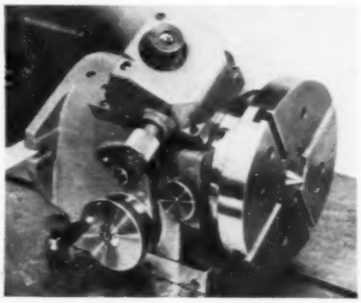
A full length cam shaft connected by chain to the drive unit furnishes an accurate method of timing electrical, pneumatic and mechanical work operations during both the indexing and dwell periods of cycling. Many work station operations can be performed by the cam shaft by using mechanical linkages.

An automatic, adjustable torque safety clutch, and a manual device to disengage the carrier chain are used to provide safe smooth operation of the machine, without sacrificing indexing accuracy.

Benerson Corp., 1319 W. Florida St., Station A, Box 127, Evansville, Ind.
T-6-41

Dividing Head

The OMT-Optical dividing head, primarily for inspection and light machining purposes, affords direct readings to 2 seconds of arc by employing an illuminated micrometer eye piece. For coarse adjustment, an external scale ring is provided close to the eyepiece. Rotation is effected by a hand wheel through a worm and worm wheel, which can be disengaged for rapid positioning simply by movement of a lever. A posi-

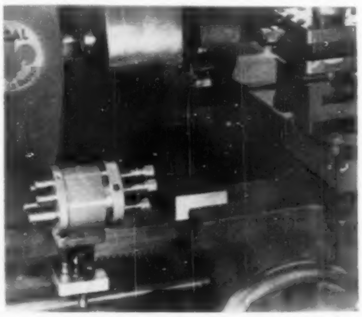


tive nondeflecting looking device is operated by a knurled knob adjacent to the eyepiece. Work can be held either in collets or between centers, and a face plate is provided. Tailstock and a base plate unit are standard equipment. Center height is $3\frac{1}{4}$ in. and maximum distance between centers is $14\frac{1}{2}$ in.

George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y. **T-6-42**

Carriage Stop

Universal lathe carriage stop provides positive cutting depth control for lathes in any of six preselected positions. Six threaded stops afford positive and accurate control over length of lathe travel. Component attaches to the bed of 90 deg lathes; for other types of beds



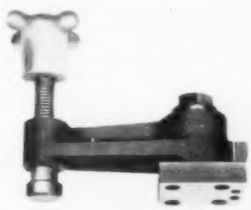
an adaptor is available.

A threaded-screw principle, which makes almost any depth adjustment quickly possible facilitated adjustments of stops. A lock is also provided which holds the stop in place, yet prevents dimpling of the stop.

G/K Products, 9548 Gidley St., Rosemead 76, Calif. **T-6-43**

Swing Clamp

Designed for ease of application, this mounted swing clamp has pivot post machined from solid block and a base that is secured to fixture by 4 socket-



head screws. The clamp is available in five sizes.

West Point Mfg. Co., 26935 W. 7 Mile Rd., Detroit 19, Mich. **T-6-44**

USE READER SERVICE CARD ON PAGE 267 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Small Bore Gage

The Bore-Test, a compact, versatile comparator, will indicate taper, bell mouth, out of round, and other dimensional variations of bores ranging in size from 0.057 through 0.810 in. The

instrument may be used in blind or multiple diameter holes.

A variety of measuring heads are used with each gage; may be quickly interchanged without keys or wrenches.

Alina Corp., 122 E. Second St., Mineola, L. I., N. Y. **T-6-45**

30 LB. THOR AIR HOIST LIFTS OVER 30 TIMES ITS OWN WEIGHT

NEW!

Fastest lifting, fastest lowering rate of all small air hoists!

Thor PORTABLE POWER TOOLS

Best control for pin-point load spotting!

Here's real husky lifting power—Thor's new compact, portable air hoist which can be handled easily by one man. Lifts up to 1000 lbs. Infinitely variable speed control from dead slow to 50 ft. per minute lift, 96 ft. per minute descent under full load—all in one hoist! Ask for Bulletin No. JE-2367 for complete details. Better yet, see a demonstration in your own plant!

Thor Power Tool Company
Prudential Plaza, Chicago 1, Ill.
Branches in all principal cities

Men at Work

Harry E. Gude was made vice-president for manufacturing of the Aluminum division of Olin Mathieson Chemical Corp. He formerly was general manager of the division's rolling mill. He succeeds Albert J. Berdis who will become president of the Weirton Steel Co.

Gustav O. Hoglund, head of the Welding Section of the Aluminum Co. of America Process Development Laboratory, is new president of the American Welding Society. He takes office June 1 to serve during the 1958-59 fiscal year.

Saul S. Schiffman is now chairman of the board at Tenney Engineering, Inc. He also continues as secretary-treasurer and chief financial officer of the company.

Several appointments at Surface Combustion Corp. involved **E. W. Weaver** as staff assistant to the vice-president, engineering; Don Beggs as manager of engineering, Furnace Div.; **O. E. Cullen** as manager of research and development department; and **J. Montagino** as chief engineer, Special Heat Treat Div.

Announcement of the appointment of **William T. Snebold** as vice-president and general manager has been made at Hycon Mfg. Co. Mr. Snebold has been financial vice-president and secretary-treasurer and continues in the capacity of secretary-treasurer.

Frank G. Sorensen, Jr. was named plant superintendent at Elmes Engineering Div. and King Machine Tool Div. of American Steel Foundries. He formerly was works manager of Cincinnati Gear Co.

The Yale & Towne Mfg. Co. directors have advanced both **Elmer F. Franz** and **John A. Baldinger** to the office of vice-president. Mr. Franz, who now is vice-president and treasurer, has been the company's treasurer since 1949. Mr. Baldinger continues to serve in Philadelphia as general manager of the Yale Materials Handling Div.

Several management changes have been made at Merkle-Korff Gear Co. **John D. Simms,** assistant vice-president, assumes administrative duties relating to sales. **Robert J. Marlatte,** former vice-president in charge of manufacturing and engineering of the Production Instrument Co., succeeds Mr. Simms as plant manager. **Ray Schroeder,** with extensive experience as a service engineer with manufacturers in the vending machine field, fills the new post of service engineer.

Herbert A. Beyer, Jr. is now vice-president in charge of sales and a director of DeVlieg Machine Co. He previously was sales manager of DeVlieg.

Appointment of **Arthur J. Welch** as vice-president and general manager of the Spring Div. has been revealed by Borg-Warner Corp. Associated with the division for the past 16 years, he has been vice-president and assistant general manager for the past year.

William A. Reich was made manager of the engineering section of General Electric Co.'s Metallurgical Products Dept. Prior to this appointment he was manager of advance engineering.

Edward I. Brown was recently appointed director of engineering for the Machinery Hydraulics Div. of Vickers Inc. He was chief engineer, Torrance Plant, Aero Hydraulics Div. of Vickers.

Peter C. Rossin is new technical director of the Refractomet Div. recently established by Universal-Cyclops Steel Corp. He has been manager-pilot plant section of research and development.

Lead Industries Association at its 30th annual meeting elected John D. Bradley to serve as president and board chairman for the coming year. He is president of The Bunker Hill Co. Vice-presidents elected for the association included **F. S. Mulock** of United States Smelting Refining and Mining Co., **Felix Edgar Wormser** of St. Joseph Lead Co. and **Kenneth W. Green** of The Electric Storage Battery Co.

At the recent annual meeting of the board of directors of American Zinc Institute, **S. D. Strauss** was reelected to serve as president for another year. He is vice-president and manager of sales for the American Smelting and Refining Co.

At Boston Gear Works, **Martin T. Schumb** was made chief consulting engineer. He has directed the engineering operations of the firm for the past 35 years. Succeeding Mr. Schumb as chief engineer is S. George Belezos who has been chief assistant since 1949.

Directors of Universal-Cyclops Steel Corp. elected **Donald W. Frease** as chairman of the board. He is president of Empire-Reeves Steel Corp., a wholly owned subsidiary, and was a vice-president of Universal-Cyclops. At the same time **William G. Stewart** was re-elected president and chief executive officer of the company. Mr. Frease succeeds **Edward L. Stockdale** who was named honorary chairman of the board.

New president of Feller Engineering Co. is **E. G. Klein.** He succeeds **Karl Feller**, retired, who continues to be a director of the company. Mr. Klein formerly was vice-president of the Transocean Trading, Inc.

Micromatic Hone Corp. has appointed **Joseph L. Pulliam** as sales manager. Mr. Pulliam, who has been with the organization since 1942, has been North Central regional manager for the past two years.

Appointment of **John E. Puvogel, Robert I. Cratch** and **John M. Thomas** as vice-presidents in charge of manufacturing, marketing and new product planning and development respectively, has been announced by Hoskins Mfg. Co. Mr. Puvogel has been manager of manufacturing for the past eight years. Mr. Cratch has served as market analyst, sales manager and manager of marketing. Mr. Thomas was manager of the company's metallurgical research and development department.

Several administrative appointments recently were made at Giddings & Lewis Machine Tool Co. **Edgar L. McFerren**, former general manager of the G&L and Hypro Div., was named vice-president-sales. **George K. Cassady**, now general manager-field sales for the corporation, was general manager of the Davis Boring Tool Div. Succeeding Mr. Cassady at his former post is **Walter B. Wigton** who has been chief engineer of the G&L and Hypro Div., a spot now filled by **Walter L. McCann** who was assistant chief engineer. **William M. Ritter** was assigned the position of sales manager of the Davis Div. while **Harry C. Soukup** is acting general manager of the G&L and Hypro Div. and continues also in his capacity of works manager of that division. All six men are members of ASTE's Fond du Lac chapter.

Albert T. Both, who has been works manager of the Cleveland Mill Div. of Chase Brass & Copper Co., subsidiary of Kennecott Copper Corp., is now assistant vice-president-operations. His former post is being filled by **Howard C. Walters** who joined Chase in 1956 as assistant works manager.

Martin C. Butters has been named executive vice-president of Brubaker Tool Corp. He also will direct operations of the Morton Machine Works, wholly owned Brubaker subsidiary. Mr. Butters is a member at large of ASTE.

Other personnel title changes at Brubaker involved George N. Fairchilds, vice-president in charge of sales, Jesse W. Elliott, vice-president in charge of manufacturing, and James E. Barnette, secretary and treasurer. Mr. Fairchilds is a member of ASTE's Central Pennsylvania chapter.

Magnesium Co. of America has revealed appointment of **Charles L. Thompson** as general sales manager of the corporation. He brings to his new responsibility broad experience in sales, sales management and administration in the light metal industry and material handling equipment field.

Geoffrey Grange is new sales manager for the C. A. Norgren Co. For the past seven years he was managing director of C. A. Norgren Ltd., the company's manufacturing licensee in Shipston-on-Stour, England.

William F. S. Dowlding was made director of quality control for Long Mfg. Div. of Borg-Warner Corp. Formerly technical assistant to the president, he now succeeds **Leo W. Cartier** who was transferred to another Borg-Warner division.

who's meeting and where

June 8-13. Society of Automotive Engineers. Summer meeting, Chalfonte-Haddon Hall, Atlantic City, N.J. For details write society office, 485 Lexington Ave., New York 17, N.Y.

June 8-13. Pennsylvania State University. Industrial training clinic conducted in cooperation with the American Society for Training Directors. Write to Prof. Ray S. Farwell, Extension Conference Center, The Pennsylvania State University, University Park, Pa.

June 9-12. Materials Handling Conference. Public Auditorium, Cleveland, Ohio, sponsored by American Society of Mechanical Engineers, to be held concurrently with National Materials Handling Exposition. Send inquiries to exposition managers, Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N.Y.

June 9-13. The Pennsylvania State University. Automation seminar. For complete information, write to Engineering Seminars, Extension Conference Center, The Pennsylvania State University, University Park, Pa.

June 9-20. Industrial Distributors Ltd., Diamond Research Laboratory of Johannesburg, South Africa sponsoring special summer course on shaped diamond tool technology at Illinois Institute of Technology, Mechanical Engineering Dept., Technology Center, Chicago, Ill. For more data write to Dr. F. D. Carvin, Dept. of Mechanical Engineering, IIT, 3300 S. Federal St., Chicago 16, Ill.

June 9-21. International Organization for Standardization. Triennial meeting, Harrogate, England. U. S. member is American Standards Assn., 70 E. 45th St., New York 17, N.Y.

June 10-20. Purdue University. Twelfth annual advanced short course in quality control by statistical methods, Purdue University campus, Lafayette, Ind. For more data, contact Prof. Irving Burr, Statistical Laboratory, Purdue University, Lafayette, Ind.

June 12-14. American Institute of Industrial Engineers. Ninth annual national conference and convention, Hotel Statler, Los Angeles, Calif. Get further information from the institute, P.O. Box 22069, Los Angeles 22, Calif.

June 16-20. American Society for Engineering Education. Annual national meeting, University of California, Berkeley, Calif. Details of the meeting may be had from Prof. E. P. DeGarmo, Div. of Industrial Engineering, University of California, Berkeley 4, Calif.

June 15-19. American Society of Mechanical Engineers. Semiannual meeting, Statler Hotel, Detroit, Mich. For details, write society headquarters, 29 W. 39th St., New York 18, N.Y.

June 15-28. Material Handling Training Conference, Industrial Management Center, Lake Placid Club, Essex County, N.Y. James R. Bright, director, Industrial Management Center, 56B Robbins Rd., Lexington, Mass. can answer inquiries.

June 16-28. State University of Iowa, College of Engineering. 19th annual management course, Iowa City, Iowa. Obtain further information from J. Wayne Deegan, 122 Engineering Bldg., State University of Iowa, Iowa City, Iowa.

June 17-20. Cornell University, College of Engineering. Industrial Engineering seminars in industrial management, manufacturing engineering, small plant management, methods and work

measurement, data processing systems, applied industrial and engineering statistics, and statistical aspects of component reliability. Address inquiries to Prof. Andrew Schultz, Jr., Dept. of Industrial and Engineering Administration, Industrial Engineering Seminars, Upson Hall, College of Engineering, Cornell University, Ithaca, N.Y.

June 17-27. MASSACHUSETTS INSTITUTE OF TECHNOLOGY. Special summer program on behavior of metals and design requirements for elevated temperatures. Get more data from Prof. Nicholas J. Grant, Dept. of Metallurgy, or Prof. Maurice E. Shank, Dept. of Mechanical Engineering, M.I.T., Cambridge, Mass.

June 17-20. CORNELL UNIVERSITY, Dept. of Industrial and Engineering Administration, Sibley School of Mechanical Engineering. Annual industrial engineering seminars, Cornell, Ithaca, N.Y. For details, write Andrew Schultz, Jr., Dept. of Industrial and Engineering Administration, Cornell, Ithaca, N.Y.

June 17-21. MASSACHUSETTS INSTITUTE OF TECHNOLOGY. Special summer program in casting of light metals, MIT, Cambridge, Mass. Send for more information to Prof. Howard F. Taylor, Foundry Metallurgy, MIT, Cambridge 39, Mass.

June 17-27. MASSACHUSETTS INSTITUTE OF TECHNOLOGY. Special summer program in metal cutting at MIT, Cambridge, Mass. Get more information from Prof. Milton C. Shaw, Metals Processing Div., MIT, Mechanical Engineering Dept., Cambridge 39, Mass.

June 19-July 3. THE PENNSYLVANIA STATE UNIVERSITY. Summer engineering seminar on materials engineering design for high temperatures. Details may be obtained from Engineering Seminars, Extension Conference Center, Penn State, University Park, Pa.

June 22-27. AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting and apparatus exhibit, Hotel Statler, Boston, Mass. Society office, 1916 Race St., Philadelphia 3, Pa. can give data.

June 22-27. PENNSYLVANIA STATE UNIVERSITY. Seminar in creative engineering. For more facts, contact Prof. Maurice S. Gjesdahl, Extension Conference Center, The Pennsylvania State University, University Park, Pa.

June 26-27. SOCIETY OF THE PLASTIC INDUSTRY, INC. Midwest section conference, French Lick-Sheraton Hotel, French Lick, Ind. Get other data from society office, 250 Park Ave., New York 17, N.Y.

TOOL ENGINEERING in Europe

By M. Kronenberg
Consulting Engineer

Mechanism of Grinding

Inserting a platinum wire into a very small hole in the workpiece and fixing it there with insulating shellac has been used by J. Peklenik to investigate the mechanism of grinding. He describes this method in detail in an article in *Industrie Anzeiger*, January 3, 1958, pages 10-17. The title of his article is: "Der Mechanismus des Schleifens und die Ueberschliff-Zahl."

The grinding process is studied by means of a statistical analysis of temperature measurements. The temperature is generated at individual grains during grinding. As each grain of the grinding wheel cuts the surface of the workpiece some wire is cut, local welding occurs, and the setup acts as a platinum-steel thermocouple. The thermocouple permits recording the sharp peak as each grain cuts the wire and the background level of temperature during grinding. The distance between peaks is a measure of the distance between the grains on the wheel.

This research shows that the effective distance between the grains depends on the grain size and on the feed rate. The distance is greater for fine grained wheels than for coarse ones. From the result the number of necessary passes can be calculated for various grinding conditions.

Surface Treatment of HSS Tools

Various methods of surface heat treating of high-speed steel tools are discussed by H. D. Weckener in *Werkstatt und Betrieb*, 1958, No. 1, pages 33-38, under the title: "Oberflaechen-Behandlung von Werkzeugen aus Schnellarbeits-Stahl und ihre praktische Anwendung."

The method of testing the hardness of very thin layers is carefully examined. The author differentiates between three groups of surface treatments: those where no chemical process is involved in the depositing of the layer

material and those where diffusion takes place, changing the base material of the tool. A third group includes methods which fit into either of the first two groups, the difference being that the tools must be treated after each grinding. Group one comprises chromium plating and electrolysing. The second group includes steam treatment, nitriding and electrolytical polishing. The third group covers sulfidizing, shot lapping and other methods.

In the case of chromium plating it is necessary to limit the thickness of the layer to 0.0008 inch. Hardness was measured with a very small load at 800 to 950 Vickers units. The author indicates that chromium plating is not recommended when the cutting forces are high or where a substantial twist may occur, as in drilling small holes. The chromium layer becomes soft at temperatures of about 660 F. Hence, chromium-plated tools prove successful mainly when machining aluminum, magnesium, copper and the like. The author mentions a case where tool life improved 118 percent when drilling copper with a chromium plated twist drill, but dropped 32 percent when drilling steel.

Nitriding, on the other hand, produces a very hard surface caused by the nitrogen reacting with vanadium, chromium, molybdenum and tungsten in high-speed steel. Nitriding is particularly recommended for reamers, milling cutters, twist drills, taps, form tools, lathe tools, cutoff tools and broaches.

Steam treatment, first developed in the United States, is based on a reaction of oxygen with the metals in the tool, producing a layer of oxidation.

The author also presents examples and principles of numerous other methods, such as the Durgi treatment developed in Switzerland, the molybdenum-sulphur treatment and others. A literature survey covering 38 publications, including Russian articles, concludes the paper.

Thermal Expansion of Machine Tools

In an article published in *Maschinen Markt*, March 1958, No. 1, by H. Wolfbauer, the thermal expansion of machine tools is discussed. This expansion is still often disregarded in practice.

The author differentiates between heat generated in the machine itself and that radiated from the surrounding space. He indicates that substantial inaccuracies are generated in workpieces due to thermal expansion of the machine tools. Jig borers are a good example of the fact that geometric accuracy can be affected by heat. A compensating device that minimizes thermal expansion is discussed. A graph shows that the peak distortion

was reduced by 75 percent when the machine was running at 1000 rpm.

Other topics covered include the bi-metallic effect of white cast iron versus gray cast iron, the heat dissipation by the motor towards the machine instead of away from it, and the effect of over-hanging portions of the machine on thermal expansion.

Magnetic Measuring Device

A magnetic device for measuring and increasing the accuracy of gear cutting machines has been developed by Czech Research Institute for Machine Tools and Metal Cutting at Prague, as described by K. Stepanek in *Werkzeugmaschinen-Praxis* February 7, 1958, No. 11. The usual measuring methods, it is claimed, are often not sufficiently accurate due to interruption of the measuring procedure from tooth to tooth, the effects of thermal expansion, slow processing and so on.

The new method is very sensitive and it is possible to determine errors down to 1/10 of a second of an angle. Magnetic disks are attached to the machine and waves are produced at different places. Their phase angle is a measure of the accuracy of the gear.

It is necessary to have the machine run before measurements are taken. An analysis of the results permits very accurate determination of both the magnitude of the cyclic error and that of the accumulated error. Furthermore, the effect of a displacement of the axis of rotation of the table can be determined.

It is planned to develop the magnetic measuring method for different applications on machine tools, particularly for automatic positioning, programming and other cases where it is necessary to measure parts, angles and velocities with extreme accuracy.

"European industrialists feel that the future and salvation of Europe depend upon the development and refinement of free-trade agreements. They believe it will take ten years to achieve full free trade among European nations.

"The removal of tariff barriers will greatly strengthen the economy of Europe. A strong Europe is necessary for our survival even though it poses competitive and industrial problems. These problems must be solved. Possibly, understanding could be achieved through interchange of information, starting at the level of tool engineering. Whatever part we can have in encouraging and developing such an understanding with mutual cooperation would indeed be worthwhile."... *from a paper delivered by John W. Greve, editor of* THE TOOL ENGINEER, *before the 26th Annual Meeting of the American Society of Tool Engineers.*

good READING

TOOL AND DIE DRAFTING—*By Theodore W. Hoover and Herman G. Schumacher. Published by Royalle Publishing Co., Inc., Detroit, Mich. Copies may be obtained by writing Maruil Book Co., 33 W. Warren Ave., Detroit, Mich. Price $3.60 194 pages.*

Tool design is that branch of machine drafting which concerns itself with the planning and design of devices and machines used in the mass production of a product. It is a specialized field of drafting and, with the steadily increasing demand for toolmakers, die makers, detailers and designers, it became necessary to develop instructional materials which would prepare personnel for these positions.

The material in the text has been used to teach the fundamentals of drafting through the use of "live" tool, die and fixture parts rather than an assortment of wooden blocks which have no functional value. As the novice tool designer learns generally by doing rather than by reading, lengthy and wordy explanations have been carefully avoided in this text.

The book is designed as a basic course from fundamentals through simple layout and design and can be used in high schools, apprentice training programs, junior colleges and technical institutes. Section XII of the book contains a suggested outline of courses for tool and die design for individual use or for instructors.

In general, the book is an up-to-date approach to the problems of teaching engineering students the basic steps of tool and die designing.

PROCESS INSTRUMENTS AND CONTROLS HANDBOOK—*By Douglas M. Considine, et al Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price $19.50. 1383 pages.*

With comprehensive and detailed coverage of control equipment and data, this handbook satisfies a long-felt need

of industry to have a complete reference work on the subject. The content extends into every phase of control and measurement.

The discussion is organized into sections comprising general fields of control and measurement such as: flow, pressure, temperature, liquid-level, and chemical-composition. In addition, separate sections are devoted to automatic controllers and final control elements.

Complete treatment of basic principles and their applications to available equipment is included in each section. Extensive engineering information in the form of tables, formulas and charts is included to aid in selection and application of equipment to specific control problems.

Almost every manufacturing and engineering research endeavor requires some type of instrumentation. This review and compilation of techniques and principles of measurement and control supply a valuable tool for attainment of the most efficient manufacturing process control.

IDEAS, INVENTIONS AND PATENTS—*By Robert A. Buckles. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. 270 pages. Price $5.95.*

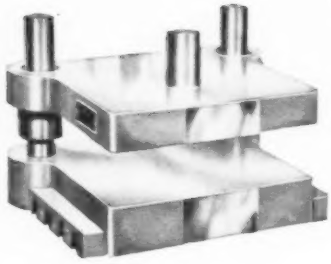
The author, who is a patent attorney, discusses the patent system in terms to assure understanding by engineers and inventors. Legal jargon is avoided as he discusses the principles that underlie patents for various fields of technology. Many sketches are used to illustrate the principles of patents for specific conditions. What is an invention, who may get a patent and how to keep patent records are all parts of this book.

The reader is taken step by step through a complete case history of a simple invention, providing an unparalleled guide for the reader who has had no previous experience with the patent office.

STAINLESS STEEL FABRICATION—*Published by Allegheny-Ludlum Steel Corp. Available by writing on company letterhead to the Advertising Dept., Allegheny-Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa. 384 pages.*

General characteristics of stainless steel including the fabrication properties and corrosion resistance of various types are found in the first sections of this comprehensive study of stainless steel. Other chapters include discussions of cutting operations, joining, cold forming, hot forming, machining, heat treatment and surface treatment. The book has more than 140 photographs, 120 charts and graphs and about 200 special diagrams on making this metal into products.

HANDLE LARGE AND SMALL DIE SETS SAFER·FASTER·MORE EFFICIENTLY



ONLY SUPERIOR *precision all steel*
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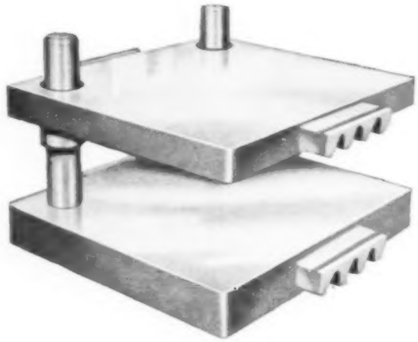
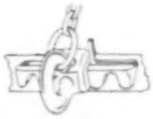
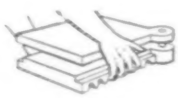


Three features exclusive with SUPERIOR DIE SETS permit rapid assembly, disassembly and overall handling of large and small die sets. In addition they provide safety insurance . . . protection for the skilled hands of die makers and handlers . . . protection also against the ruining of costly dies in handling, or even damaging of valuable press equipment. **In addition, all Superior Die Sets are jig bored to your specifications — result number of sizes practically limitless.** Write for FREE 24 page Catalog on Superior Die Sets and Supplies.

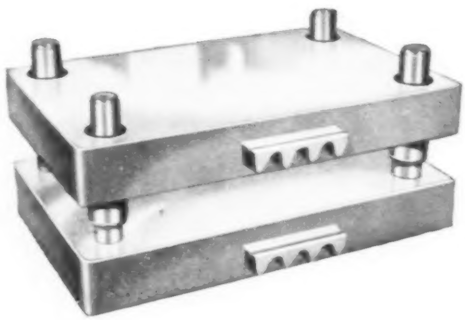


LOCK-JAW LIFTING DEVICE
removes the danger of handling large die sets.



SAFETY FLANGE
protects fingers by providing roomy gripping space on either side of the die shoe.

E-Z LIFT SLING CHAIN
attach to the lock-jaw for immediate lifting.



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Indianapolis, Ind. Clifford 5-5668	Denver, Colo. Enterprise 234	Agawan, Mass. Republic 9-1132
Rockford, Illinois 3-3931	Winter Park, Fla. 4-0464	Brooklyn, N. Y. Esplanade 6-1368
Dayton, Ohio Hemlock 6209	Racine, Wis. Melrose 2-1900	Cheshire, Conn. Browning 2-4887
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FIELD notes

A patent covering electrolytic grinding has been issued by the United States Patent Office to George F. Keeleric, inventor of the process, according to Anocut Engineering Co., exclusive licensee under the Kelleric electrolytic grinding patent rights. The patent has eighteen claims and covers the ideas of using a conductive grinding wheel with abrasive elements protruding from its surface.

V V V

Hughes Aircraft Co. and Monogram Precision Industries, Inc. have signed an agreement permitting the latter company to manufacture a new group of microwave devices developed by Hughes' research and development laboratories. The license makes available to the Cascade Research division of Monogram Precision, technical information developed by Hughes for production of very wide band ferrite isolators. This marks the first time Hughes has licensed another firm to employ these particular developments and inaugurates a new program aimed at additional agreements with other companies in a variety of electronic fields.

new facilities

The Electro Minerals Div. of The Carborundum Co. has opened a Product Development laboratory containing a wide variety of equipment for product development and testing. It also provides pilot plant facilities for developing manufacturing processes required for new products and improvement of processes used in existing plants.

V V V

A new production facility offering both accurate and ultra-precision gears in low and moderate production quantities is being made available to industry by National Broach & Machine Co. Company president, Walter S. Praeg emphasized that the facility is not designed to compete in any way with conventional gear jobbing shops. It enables National Broach to provide a complete gear production service including development of cutting tools, development of special tooth forms for heavy load applications, recommendations for tolerance specifications, and analysis of gear designs for gears ranging from the smallest to those having high helix angles and large pitch diameters.

V V V

A modern factory building and facilities have been completed in Closter, N.J. for Electro-Autosizing Machine Corp. The firm's former connection as a division of Industrial Gauges Corp. was severed effective January 31, and it is now organized as an independent corporation. New address of Electro-Autosizing is 7 William St., Closter, N.J.

V V V

Construction is under way on a 10,000-sq ft regional headquarters building in Pittsburgh for combined activities of Square D Co. and Electric Controller & Mfg. Co.

V V V

A modern, seven-story office building has been completed by Allis-Chalmers Mfg. Co. across the street from its main office. The new structure comprises 110,000 sq ft of floor space and will provide office space for more than 800 employees.

new companies

Cen-Tec Corp., a subsidiary of Centri-Spray Corp., Livonia, Mich., has been organized to design and build hydraulic, electronic and pneumatic test equipment for laboratory and production use.

V V V

Formation of The Ducker-Singer Co. has been completed. The new firm, located at 312 E. Brown, Birmingham, Mich., will be staffed with consultants in product design and development, market research, processing, cost control and most phases of scientific engineering. It will develop a product or line of products to meet needs of the market within limits of the client's facilities. In addition to consulting service, the company will manufacture and offer for sale a range of automatic materials handling equipment.

research

Chance Vought Aircraft, Inc. has contracted with three West Coast foundries to conduct research into three different methods of casting high strength steel parts for supersonic aircraft. The contracts, which amount to approximately $250,000 each, were awarded to Stanley Foundries, Mercast Corp. and Pacific Alloys. Each company will work on a different configuration casting, using its own special technique for production. Primary purpose of the project is to develop processes of casting new high strength steels into complex shapes required by the aircraft industry for high-speed aircraft and missiles of the future.

trade associations

National Tool & Die Manufacturers Assn. are offering for the second year to the entire metalworking and plastics industries their 1958 pocket-size directory of Special Tooling Services which lists more than 1,000 contract tool and die plants throughout the United States and Canada. Information includes company name, address and telephone number, as well as names of individuals to contact and the specific products and services offered by each association member. An innovation inaugurated in this year's book is the system of classifying the size of work that each member company can handle. Previous designations included "small," "large" or "extra-large" dies, whereas the new directory also specifies maximum weight indicated for each class of work.

Copies of the 1958 directory can be obtained from George S. Eaton, NTDMA, 908 Public Square Bldg., Cleveland 13, Ohio.

V V V

The Material Handling Institute, Inc. has inaugurated an Industry Awards Program endorsed by and with the cooperation of Pressed Metal Institute. Purpose of the program is (1) to demonstrate that application of fundamental principles and rules governing economical and safe handling and distributing industry's products contributes to increased productivity, lower product cost, product protection, better customer service relations, better employee relations, and strengthened national economy; (2) to reaffirm that improved and economical handling methods are both possible and practi-

cal; and (3) to provide documented case studies with detailed procedures that can be adapted objectively to any handling problem. Company or firm awards in the form of plaques will be presented to first, second or third place winners. Cash awards of $1,000, $750 and $250 will be divided among individuals named by the company or firm entrant as having participated in preparation of the entry. The contest closes October 13, 1958.

expansions

More than $3-million is being earmarked by The Timken Roller Bearing Co. for investment in modernization of the cup and cone grinding departments of its Canton and Columbus, Ohio, bearing plants, and for new major equipment for its Bucyrus Bearing Plant. About 117 machines, including cup and cone grinders, cone honers and cup air gages have been ordered from The Heald Machine Co. and Cincinnati Milling Machine Co. Development of the new machinery has been underway at the two companies for some time. Delivery is expected late in 1958 and pilot equipment is due to arrive in Canton in June, July and August for testing.

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An estimated $275,000 is going into construction of a steel warehouse for the Steel and Tube Div. of The Timken Roller Bearing Co. The building will be located on the company's property at Gambrinus, Ohio. Included in the building will be storage space and offices for warehouse and shipping personnel. Completion date is expected to be the first of July.

√ √ √

E. F. Houghton & Co. has completed construction and equipping of expanded manufacturing facilities in Detroit. The construction, which more than doubles plant capacity, incorporated a fully equipped laboratory which will strictly control all of the plant's processing.

√ √ √

A plant expansion program at Illinois Gear & Machine Co.'s South Works has been completed. Principal feature of the program is the heavy machinery building which is 300 ft long by 80 ft wide with railroad track through the center. The building has a double crane with lifting capacity of more than 50 tons.

moves

Executive offices of The Siegler Corp. have been moved to a new, permanent location at 610 So. Harvard Blvd., Anaheim, Calif. The new home provides a centrally located office for coordinating activities of the company's seven Southern California plants.

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Onsrud Machine Works, Inc. has relocated its Portable Tool Div. from Chicago to 7720 Lehigh Ave., Niles, Ill., a suburban industrial area north of Chicago, to obtain needed space for enlarged engineering and manufacturing facilities.

√ √ √

With move of itis northeastern headquarters from Newark to a new building in Springfield, N.J., The DeVilbiss Co. completed another step in its nationwide program for relocating and expanding direct factory branches. The new facility, with more than 11,000 sq ft of floor space, includes a testing

and demonstration area, repair, rebuilding and exchange center and sales, engineering and administrative offices for DeVilbiss and its recently acquired subsidiary, Newcomb-Detroit Co. (now the Newcomb-DeVilbiss Co.).

V V V

According to recent announcement, from Brubaker Tool Corp., the recently acquired Morton division has been moved from Detroit to the Millersburg, Pa., area.

V V V

Ready Tool Co. has moved its plant to 150 Garfield Ave., Stratford, Conn. because of construction of the Connecticut Turnpike which forced the firm to leave its Bridgeport, Conn. home.

new divisions

A Glennite Instrumentation Div. has been established by Gulton Industries, Inc. for development and production of high accuracy sensing devices, data handling systems and digital automatic computors to operate at greater capacities with a reduction of systems costs. The division will specialize in electromechanical and electronic instrumentation for complete monitoring and control systems in general industrial and military applications and particularly the processing industry.

V V V

Open house marked formal opening of the Santa Ana Div. of Flexonics Corp. The facility represents a major step in the company's planned program of expansion. Location for the division was chosen to bring a full complement of technical, design, production, sales and warehousing services to Flexonics' western regional area, which includes all territories west of the Rocky Mountains.

acquisitions

Dana Corp. has announced purchase of Chelsea Products, Inc., as part of its policy of diversification and of broadening and expansion of its activities.

V V V

Arter Grinding Machine Co. has been purchased by Sundstrand Machine Tool Co. as another step in its expansion and diversification program. Involved in the purchase was Arter's name, inventory, patterns, fixtures and patents. Building and land were not included. Arter assets acquired by Sundstrand will be integrated into the capital goods division of Sundstrand. The Arter equipment will be manufactured in the Rockford and Belvidere machine tool plants.

All remaining equipment, including the heat treat, located at the Marysville plant of Pressed Metals of America, have been purchased by Allied Products Corp. It has been added to considerable other equipment installed by the corporation in an effort to obtain a large volume of new business.

V V V

Controls Co. of America has purchased from Breese Burners, Inc. assets consisting of laboratory equipment, materials, designs, products and U.S., Canadian and foreign patents. The Breese development and engineering operations at Santa Fe and sales offices at Columbus, Ohio, will comprise a wholly owned subsidiary but will be operated independently of Controls Co. and will retain the Breese name.

Completed negotiations to acquire physical assets, business and name of Loyd Scruggs Co. has been announced by Howard Industries, Inc.

name change

Philadelphia Gear Works, Inc. changes its name, effective June 1, 1958, to Philadelphia Gear Corp. Reason for the change was to "more properly describe the company's activities in the mechanical power transmission field." No change in present management or control of the company is contemplated.

V V V

Company name of National Cylinder Gas Co. has been changed to Chemetron Corp. Directors voted to

discard the old name as having been outgrown by the company which has added new product lines and services beyond the original scope of the firm. The new designation is made up of parts of the names of three of the major industries served by the company —chemicals, metals and electronics.

corporate changes

The Ohio Electric Mfg. Co. and Howell Electric Motors Co. have been conducting merger negotiations. If approved, the merger will result in formation of a new corporation which will operate at the Howel Electric Motors Co. but will retain the Ohio, Kingston-Conley and Howell tradenames. Company officials anticipate that the new company will continue to operate all of its present plants.

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Integration of the Glendale Div. of Consolidated Electrodynamics Corp. into the company's Central Manufacturing Div. has been carried out in the interest of operating economy. According to company president, Hugh F. Colvin, the move does not affect development and manufacture of division products.

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The boards of directors of Hooker Electrochemical Co. and Shea Chemical Corp. announced formal agreement for consolidation of the two companies subject to approval of stockholders of each company. Under terms of the proposed consolidation, Hooker will be the continuing company, and its name will be changed to Hooker Chemical Corp.

new offices

A new branch office and warehouse for T. B. Wood's Sons Co. has been opened at 485 Stephens Ave., S.W., Atlanta, Ga. Joe Seawell, Jr., was named manager.

√ √ √

A Midwest regional sales office has been opened at 1355 E. 93rd St., Chicago, Ill. by Verson AllSteel Press Co. The office, staffed by experienced Verson application engineers, will serve Northern Illinois.

√ √ √

Opening of a new sales office to serve the state of Michigan as well as the Toledo, Ohio area has been announced by Miniature Precision Bearings, Inc. The office, located at 21031 Mack Ave., Grosse Pointe Woods, Mich., is under the direction of Peter L. Weinert.

Trade Literature

for free booklets and catalogs—use convenient request card, page 167

Air Gaging

Where and how to use Plunjet air gaging cartridges in single and multiple dimension gages and inspection fixtures is described in illustrated 32-page Catalog No. PGC-58-1; includes complete engineering specifications on Plunjets and typical applications. Request only on company letterhead directly from The Sheffield Corp., Dayton 1, Ohio.

Milling Machines

Design features and advantages of company's line of dial type milling machines discussed in extensively illustrated 46-page Catalog M-2003; it includes specification tables and dimensional drawings. The Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **L-6-1**

Tube Mills

Use of modern tube mills in manufacture of pipe and tube described in detail in 64-page handbook "Electric Resistance Weld Tube Mills"; Provides step-by-step description of electric weld process from roll forming and shaping of tube to finished product; operation, capacity and applications illustrated by photos, drawings and charts. The Yoder Co., 5500 Walworth Ave., Cleveland 2, Ohio. **L-6-2**

Dial Indicators

Four-page illustrated Bulletin No. 200 describes main features of new line of dial indicators. SEMA Corp., P.O. Box 176, Boston 72, Mass. **L-6-3**

Lead Errors

Extensively illustrated by photos, drawings and charts, 16-page booklet, "A New Look at Lead Error," discusses its guises and cures, shows resultant faulty effects of such error and how to avoid the problem. Standard Pressed Steel Co., Jenkintown, Pa. **L-6-4**

Investment Castings

Eight-page, well illustrated brochure offers information on designing for investment castings; covers such factors as fillets, holes, threads, wall thicknesses and tolerances. Section discusses ferrous and nonferrous alloys which can be used for investment castings. Casting Engineers, Inc., 2323 N. Bosworth Ave., Chicago 14, Ill. **L-6-5**

Milling Machines

Twenty-page illustrated brochure of "Sundstrand Model C Rigidmils" describes and shows the machines in full, highlights important construction details and design features and points out advantages of the equipment in operation; includes specifications and dimensions. Sundstrand Machine Tool Co., 2531 Eleventh St., Rockford, Ill. **L-6-6**

Pitch Diameter Measurement

Illustrated with engineering drawings, 16-page combined Bulletins 400 and 401 deals with the question of "Does the three-wire system measure true pitch diameter?" and "Effectiveness of various contacting elements used for gaging and measuring pitch diameter." The Johnson Gage Co., 534 Cottage Grove Rd., Bloomfield, Conn. **L-6-7**

Lubricant Coatings

Preparation of metal surfaces for proper application of Molykote resin bonded lubricant coatings covered in detail in 24-page, pocket-size Bulletin 115, includes instructions for metal degreasing, phosphating of stainless, sandblasting of chrome plate, anodizing of aluminum, etc., plus application details for lubricant coating by spray or dip, and required baking times. The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn. **L-6-7**

C-Clamps

Design features and advantages of recently introduced line of C-clamps described in illustrated Catalog No. 692. Wilton Tool Mfg. Co., Inc., Schiller Pk. Ill. **L-6-8**

Carbide Bushings

Complete descriptions and specifications of Meyco carbide inserted drill jig bushings presented in illustrated catalog including slip renewable and fixed renewable bushings plus head and headless press fit types. W. F. Meyers Co., Bedford, Ind. **L-6-9**

Welding

Twelve-page, bi-monthly Linde Metalworking Bulletin is designed to demonstrate industrial advantages of manual and mechanized electric welding, spot welding and cutting processes through an average of six concise, easy-to-read articles in each issue. Request only on company letterhead directly to Metalworking Bulletin, Rm. 2840, 420 Lexington Ave., New York 17, N. Y.

Cutoff Wheels

Booklet PG-336, "Cincinnati Cutoff Wheels," describes these wheels and characteristics of the three bonded types in which they are available; includes helpful section on good cutoff practices and a table of suggested gradings for cutoff operations. Cincinnati Milling Products Div., Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **L-6-11**

Grinders

Sixteen-page, extensively illustrated Catalog B-57 presents description on 6-in. Type CH and 10-in. Type LCH plain grinders; includes complete specifications. Landis Tool Co., Waynesboro, Pa. **L-6-12**

Air Valves

Informative 108-page general catalog presents details of complete line of air control valves; departmentalized for ease of use into four sections covering 4-way valves and manifolds, 2 and 3-way line valves, manual valves and manifolds, and pilot and special valves; includes valve feature comparison chart, special circuit applications table and how-to-do-it data on manifold mounting patterns and vacuum valve applications. Numatics, Inc., Highland, Mich. **L-6-13**

Carbide

Manufacture and physical properties of tungsten carbide discussed in illustrated 20-page Carbide Technical Manual which also deals with Firthite grade selection and application, use of single point tools and recommended Firthite cutting speeds. Firth Sterling Inc., 3113 Forbes St., Pittsburgh 30, Pa. **L-6-14**

Three Dimensional Machining

Three dimensional milling and machining at high production rates discussed in extensively illustrated 12-page brochure; shows typical two work-station machine and development of space configurations through hydraulically actuated cams; also shows typical parts adaptable to process. Tri-Ordinate Corp., 335 Snyder Ave., Berkeley Heights, N. J. **L-6-15**

Cobalt in Alloys

Twelve-page Special Report No. 1, prepared by Dr. F. R. Morral, reviews needs of industry and evaluates areas requiring further research; discusses cobalt production, consumption and availability; presents information on properties of cobalt and its alloys and compares properties of various alloys. Request only on company letterhead direct from Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

Machine Tools

Entire line of precision machine tools including engine, toolroom and turret lathes, milling machines, bench shaper, drill presses and tool grinders described in illustrated 80-page Catalog No. 5800; also lists attachments, tools, chucks and accessories; tabulates specifications including capacities, floor space requirements and shipping weights. South Bend Lathe Works, South Bend, Ind. **L-6-16**

Ventilating and Exhaust Systems

Twelve-page catalog on "Thermoplastic Corrosion-Proof Ventilating and Exhaust Systems" presents details and illustrations of all necessary components to permit an engineer to design his own polyethylene ducting systems around standard components and fittings; presented so that user can determine required components, their exact cost and most convenient lengths for installation. American Agile Corp., P.O. Box 168, Bedford, Ohio. **L-6-17**

Optical Measurement

Six-page folder describes Scan-A-Scales for use on any production or inspection equipment requiring accurate, reproducible linear settings; explains how they can be used to increase production, lower costs and improve quality; outlines advantages of the instrument and gives directions for operation includes schematic diagrams and in-use photographs. F. T. Griswold Mfg. Co., 315 W. Lancaster Ave., Wayne, Pa. **L-6-18**

Cutting Tools

Expanded line of high-speed cutting tools covered in 16-page catalog; includes keyseat cutters, combined drills and countersinks, center reamers and special tools, each illustrated and completely described by dimensional tables; cross-referenced and photo indexed for fast tool selection. Fastcut Tool Co., 7405 E. Davison, Detroit 12, Mich. **L-6-19**

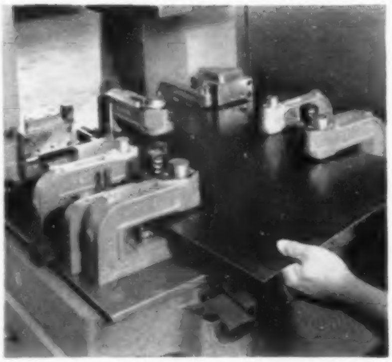
Screw Machines

Important design features of Screw-Matic 750 single spindle bar automatic presented in widely illustrated brochure. The Gear Grinding Machine Co., 3901 Christopher, Detroit 11, Mich. **L-6-20**

Throwaway Tooling

Illustrated 12-page booklet, "Throwaway Tooling Set-up and Follow-Thru" outlines in concise and practical terms how to obtain maximum throwaway tooling results through proper use of correct style holders and inserts; includes guide to grade selection and guides to maximum insert performance. Adamas Carbide Corp., Kenilworth, N. J. **L-6-21**

Strippit Punching and Notching Units are easily mounted to templates, T-slotted plates or rails in unlimited patterns for long press runs or quick-change pilot runs. Complete range of standard tools, or "specials" made up on request.



Pressure Gages

Illustrated 48-page catalog introduces line of pressure gages, giving complete engineering data and selection tables for applications in processing plant and power instrumentation. Kunkle Valve Co., 120 S. Clinton, Ft. Wayne, Ind. **L-6-22**

Drafting Aid

Sets of Layout Tracers make it easy to "lay in" various units of company's Crown Line of filters, regulators, lubricators and accessories. Outlines of various units are shown to scale on 8 permanent cards which can be slipped under a tracing. Available to machine designers requesting the tracers on company letterhead direct from Mr. H. J. Andresen, Crown Products Div., Hannifin Co., Des Plaines, Ill.

Cutting Tools

Photos and drawings illustrate 40-page Catalog No. 23 describing high-speed and carbide tools; gives pertinent application information and engineering tips on each type of cutting tool; includes tables of specifications, dimensions and prices. Severance Tool Industries Inc., 3765 Olive, Saginaw, Mich. **L-6-23**

Grinding Wheels

Features and applications of Cincinnati toolroom grinding wheels described and pictured in brochure PG-350; contains complete table of starting grades for wide range of toolroom grinding operations. Cincinnati Milling Products Div., Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **L-6-24**

Motor Pulley

Full information on construction and complete engineering details on nine sizes of company's redesigned variable speed motor pulley line presented in 20-page Bulletin V-582; well illustrated with photos and engineering drawings and includes tables of dimensions and specifications. Request only on company letterhead directly from Reeves Pulley Div., Reliance Electric & Engineering Co., 1225 Seventh St., Columbus, Ind.

Drilling Control

Illustrated folder, "Enables One Drill Press to do the Work of 5!" describes Digimatic control system for table positioning, emphasizing cost-saving advantages; provides step-by-step illustrations of automatic drilling of a typical part and makes cost comparison with hand drilling; includes complete specifications. Electronic Control Systems Div., Stromberg-Carlson Co., 2231 S. Barrington Ave., Los Angeles 64, Calif. **L-6-25**

technical Shorts

Simplify Process For Iron Ore Reduction

DIRECT REDUCTION of iron ore to pig iron or semisteel through a simple process has been demonstrated in a prototype plant at Niagara Falls, Ont., where the process was developed. The accomplishment was announced jointly by Strategic Materials Corp. and Koppers Co. For the past six months, the two firms have had a working agreement for application of certain metallurgical processes under development by Strategic.

The patented method, known as the Strategic-Udy process, is comparatively simple in operation. Equipment used consists of a rotary kiln, an electric furnace, and a standard materials-handling system.

Iron ore is mixed with fluxes and with a low-cost source of carbon. This mixture is fed into a direct-fired rotary kiln where it remains a free-flowing system of solid particles discharged at 1100 to 1300 C., depending upon the type of ores used. Combustible gas from the electric furnace may be used at the kiln, resulting in the use of very little additional fuel.

From the rotary kiln, the hot charge is immediately directed by controlled feed into the reducing zone of the electric furnace, where a short arc is slightly submerged in the slag by an electric voltage control. In the resultant intense, hot reducing zone, the charge is quickly and completely reduced. The Strategic-Udy process provides an effective control of reduction so that pig iron or semisteel can be produced. Slag additions can be made to control impurities and so produce a metal equivalent to or superior to pig iron with respect to such elements as silicon, phosphorous and sulfur.

The metal may then be cast into pigs or transferred in molten form to a refining furnace, where alloying additions may be made if desired, to produce steel. The process thus provides for the direct and continuous production.

Pilot plant tests indicate several advantages for the Strategic-Udy process. It is flexible as regards ore size. Complex ores which now are of little or no value may be used. In terms of the knowledge afforded by this process, many hitherto uneconomic iron ore deposits probably warrant re-evaluation. This process also permits considerable latitude in selection of a reductant and fuel, since coal, peat, lignite or coke may be used. Control of carbon content is possible: pig iron, for example, with a carbon content of 3.5 percent, or semisteel of 0.5 percent carbon can be readily produced. Low power requirements, in combination with the ability to use a cheap reductant, are economy factors. Flexibility of the process permits its use for large installations, or for units producing as little as 50 tons per day. Plants can be closed down entirely in a very short time and started up from the cold in three or four hours.

Engineering and cost studies indicate the commercial feasibility of the process for use near ore sites and where relatively inexpensive electric power is available, however it does not appear to be immediately competitive at existing major steel production centers.

Extrusion of titanium jet engine parts

By Neil J. Feola
Wright Aeronautical Div.
Curtiss-Wright Corp.
Detroit, Mich.

The high strength-to-weight ratio of titanium and titanium alloys offers a considerable weight advantage in aircraft applications as a lightweight replacement for mildly stressed and/or corrosion-resistant steels. Full utilization of this weight advantage, however, has been greatly hindered by the high cost of finished titanium parts. In fact, using conventional steel manufacturing methods, the cost of titanium parts has been as much as ten times greater than the cost of steel counterparts. This high premium is a reflection of the basically high cost of raw titanium material and the conventional manufacturing methods employed to transform this raw material into finished parts. The latter methods generally result in low material utilization factors. While this situation is tolerable for relatively low-cost steel, applied to titanium it results in considerable cost due solely to the loss of expensive raw material in the form of unreclaimed scrap.

To demonstrate a newly developed process, typical titanium-annular rings in AMS 4921 titanium and in the A110-AT titanium alloy were manufactured. In an engine, these rings represent end flanges for sheet-metal assemblies. Manufacture of these flanges by conventional techniques, such as forging or from wrapped and welded barstock, results in grossly oversized sections. By the newly developed extrusion method these rings were manufactured as follows: (1) the basic cross section of the rings was extruded in straight lengths with a minimum-machining envelope; (2) the extruded lengths were contour formed into 360-deg rings and flash-butt welded; and (3) the rings were sized and finally machined to finished dimensions. In this manner only one-half of the raw material (in the form of cast ingots) was required to manufacture the finished part when compared with conventional methods. An additional increment of cost savings resulted from extruding these sections directly from cast ingots rather than from forged billets.

Since the extrusion process represented the key to the manufacturing method, the major portion of the development activities was focused on this operation. These studies were conducted on the 12,000-ton horizontal-extrusion press located at Metals Processing Div. of Curtiss-Wright, in Buffalo, N. Y. This facility is equipped with containers which will permit the extrusion of stock ranging in diameter from 8 to 24 inches. Corresponding to these various diameter containers are pressure stages of 4,000, 8,000 and 12,000 tons. For this study the 4000-ton pressure stage and the 8-inch-diameter container were used exclusively. Heating of the extrusion stock was accomplished by means of a barium chloride salt bath located immediately adjacent to the press. Rapid transfer of the billet from the furnace to the extrusion chamber was accomplished by an overhead hoist.

In determining that portion of the envelope required solely by the extrusion operation, a complete study of the extrusion processing variables was performed on round sections. It was desired that this study yield lowest tolerances and maximum extrusion yield. Optimum surface finish for both alloys resulted from

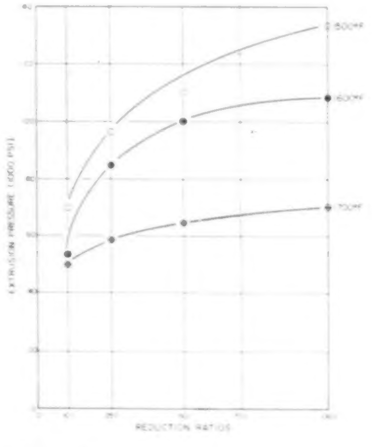


Fig. 1. The effect of extrusion temperature and ratios on the pressure required to extrude A70 titanium. Tests were run with round sections.

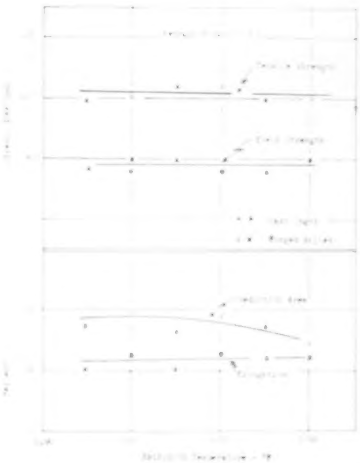


Fig. 2. Comparison between the tensile properties of extrusions made from cast ingots and forged billets.

the combinations of extrusion processing conditions:

Extrusion speed, ipm	450
Lubricant, Fiske No.	630
Container temperature, F	800
Die preheat temperature, F	750
Billet heating	Vasco Supreme
Die material	Salt bath

The differences in processing conditions for the A70 and A110AT alloys are in the entrance angle (120-140 deg and 180 deg respectively) of each die and billet temperatures (1550 deg F and 1850 deg F respectively).

These extrusion conditions resulted in an extruded product for both the A70 and A110AT materials with extrusion tolerances of ± 0.020 inch for nominal metal dimensions of less than 1.00 inch and ± 0.040 inch for material dimensions from 2.00 to 3.00 inch.

Dimensional control can be maintained for lengths of 100 linear feet for the A70 material and 15 linear feet for the A110AT alloy. For the A70 material the 100 linear feet was obtained by five 20-foot extrusions. This length limitation is a direct function of the die wear. Undoubtedly, as better die material and lubricants are developed this problem will be surmounted.

This difference in die life for the two materials provides an indication of the greater resistance to deformation afforded by the A110AT alloy. Consequently, a similar increase in extrusion pressures resulted from extruding this material compared to the A70 material, even considering the higher extrusion temperature; i.e., 1850 vs. 1550 F. These high pressures considerably limited the range of extrusion temperatures and reductions obtainable with the A110AT alloy.

A plot of extrusion pressure for the A70 material versus extrusion temperature and ratio is presented in *Fig.* 1.

Conventional extrusion practice utilizes a billet which has been forged from an ingot to fit a specific container diameter. By extruding directly from a cast ingot both the cost of the forging operation and the material lost in this operation were eliminated. Since this approach pioneered a new technique, considerable development was required to confirm the quality of such extrusions.

The results of this study indicate tensile properties well in excess of the minimum-specification requirements by extruding at 1550 and 1850 F for the A70 and A110AT materials, respectively, for extrusion ratios of 10:1 and greater.

It is sufficiently important to elaborate on the effect of extrusion temperature. For the materials studied, extruding above the beta transus (A70 1625 F —A110AT 1930 F) can result in a severe loss of ductility and subsequent embrittlement. These temperatures, therefore, represent an upper limit. The lower limit for extrusion temperature is established by the pressure requirements. The previously quoted extrusion temperatures of 1550 and 1850 F represent a compromise between these limits.

To further demonstrate the high quality of the cast ingot extrusions a comparison was made with extrusions from forged billets. This comparison is presented graphically in *Fig.* 2.

The high material utilization, associated with the developed process coupled with the use of cast ingots as the extrusion stock, resulted in an appreciable reduction of costs when compared to conventional forging techniques. For the variety of shapes examined cost savings were generally in the order of 25 percent and were, in some instances, as high as 40 percent. An additional advantage resulted in that the procurement cycle for the detail parts was reduced by 30 percent. These results are summarized in the accompanying table.

The figures for savings do not include the savings for machining. The rings manufactured by this method require approximately one-half the stock removal compared to conveniently forged sections. In general, this results in an additional saving of approximately one-fourth to one-third of the machining costs.

This process is undoubtedly the most economical method of producing titanium jet engine rings. The advantages of this process, however, do not stop here. The high material utilization inherent in the extrusion process makes it ideally suited to the production of detail shapes directly (airframe structures) and as a method of obtaining preforms for other "chipless machining" techniques.

This method is not a cure-all for reducing titanium costs. Parts with

Cost Comparison for Forging and Extrusion of Tested Alloys

Manufacturing Method	Conventional Forging	Extrusion	
		Forged Billet	Cast Ingot
Material Utilization (percent)	19	26	30
Part-cost ($/lb)	72	48	43
Cost savings (percent)	—	33	40
Procurement cycle (mo.)	6	5	4

geometries not suited for extrusion will require a similar development of fabrication techniques, all of which must be capable of high material utilization. Only through this type of development can full advantage be taken of the attractive properties of titanium.

From a paper presented at the SAE Annual Meeting, Detroit, Mich., January 1958.

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Possibilities in the Field of Dry Lubricants

By Robert L. Johnson
Lewis Flight Propulsion Lab.
National Advisory Committee for Aeronautics
Cleveland, Ohio

Research information on solid lubricants has been compiled for consideration in the possible use of such materials in aircraft electrical equipment. Solid lubricants are capable of lubricating at the maximum temperatures (600 F) for aircraft electrical equipment. Many solids that adhere well to metals may be useful lubricants; those with layer-lattice structure usually give low friction. Solid lubricants are most commonly used as bonded films but the use of fluid carriers and surface reaction products have considerable merit.

Solid lubricants have considerable potential in lubrication at extreme temperatures, high-surface stresses, and other similarly difficult conditions. Few liquids or greases may be used at temperatures as high as 450 F for any appreciable period of time, while most solid lubricants are useful at 600 F or higher temperatures. The most successful use of solid lubricants has been in resin bonded films. Other methods of utilizing solid lubricants are available but each method has specific limitations.

Most of the promising materials for solid lubricants have a layer-lattice crystal structure which provides potential easy-shear planes and are subject to beneficial orientation effects. Not all layer-lattice compounds are good lubricants, however, and some compounds that have other types of structures such as silver iodide can provide effective lubrication. An example of the inadequacy of crystal structure as a guide in the selection of solid lubricants is apparent when the results for some completely isomorphous compounds are compared. Silver sulfate was an effective lubricant, and sodium sulfate, which has the identical type of structure, failed to lubricate.

tech digests

The effectiveness of solids as lubricants can be attributed more to the formation of adherent films on the lubricated surfaces than to any particular structural type. For example, silver iodide formed an adherent film and was an effective lubricant although it does not have layer-lattice structure.

Boron nitride is a familiar example of a material that has highly desirable structure but does not lubricate. Boron nitride may become useful in solid molded bodies but in the powder form it appears to have little potential as a solid lubricant. Boron nitride lacks the ability to adhere to metal surfaces at temperatures up to 1300 F in air. Moisture has little effect on lubrication with boron nitride. It can be useful as a parting compound in molding operations because of its inert properties. When substantial surface slip occurs, however, boron nitride will not lubricate.

Graphite is probably more widely known as a lubricant than any other solid material. It has been demonstrated by various investigators that graphite requires the presence of an adjunct vapor such as moisture before it can be an effective solid lubricant. It has been reported that graphite has no inherent lubricating properties but that it depends on adsorbed vapor films on the surface of the hexagonal platelets of graphite crystals to provide low-shear strength. The possible role of the vapor as an intermediate to promote adherence of graphite to the lubricated surface has usually been considered a secondary factor. NACA studies of sliding friction and of small ball bearings, substantiate a supplementary hypothesis on lubrication with graphite. This hypothesis states that effective lubrication is possible with graphite provided one of the following two conditions is met: (1) An adsorbed vapor film is present, or (2) an oxide film of the proper type is continuously present on one or both of the lubricated surfaces.

Most of the studies that have been mentioned were made with powdered solids under conditions that allowed direct comparison of solids without the benefit of carrier bonding agents. The most successful use of solid lubricants has employed a resinous bonding agent. Several types of resins can be employed successfully including materials used as insulating cements in electrical equipment. This method of application has

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definite limitations due to endurance life. In other problem areas temperature limitations can also be important. Once the solid lubricant film is worn away or otherwise displaced from the bearing surface, it will not be regenerated, and the useful life of the part may be ended. The limiting temperature in aircraft electrical equipment, 600 F, is well within the temperature range for effective lubrication with several commercial solid-film lubricants. Molybdenum disulfide has a temperature limitation of 750 F where oxidation can be detected.

The use of a liquid or a gas as a carrier could be a potent method of utilizing solid lubricants. Stable colloidal suspensions of many solids, however, are difficult to prepare. For instance, molybdenum disulfide has a strong tendency for particle agglomeration. Thus, many difficulties might be expected in handling suspensions in circulating lubrication systems. By assuming that normally stable suspensions can be made, many of the changes that occur to oils in engine operation, such as acid formation, could adversely influence the stability of the suspensions. Further, the liquid carrier can displace the solid lubricant from the surface, because the liquid is capable of physical adsorption. In this case, the solid would no longer be the lubricant and the carrier might not provide the necessary lubrication. Very high concentrations of solids (greater than 10 percent) may be necessary to prevent displacement of the solid particles from the load-bearing area.

An air of gas fluid-dispersion technique for carrying solid lubricants to rolling contact bearings has been used successfully. This technique requires very careful control to assure the supply of the solid at the optimum rate to provide lubrication without destroying dimensional tolerances. The use of a liquid carrier that will volatilize at the operating temperature of the bearings has distinct advantages. For example, metering the supply rate is much easier with a liquid than a gaseous carrier. Also, the heat of vaporization of the carrier can be utilized in cooling the lubricated parts. With a single-pass system, an agitated slurry of the solid in its carrier fluid can be used; thus the lack of stability of solid suspensions need not be a problem.

A series of rolling contact fatigue

studies that included lubrication with powders and slurries of solid graphite and molybdenum disulfide supplied through an airjet has been reported. These data showed that the fatigue life of balls was substantially less when a solid lubricant was used than when either petroleum or synthetic base turbine oils were employed. The solid particles probably served to increase surface stresses and thus reduce fatigue life. The initial fatigue failures occurred in regions of pure rolling and not in areas where there was significant surface slip. Slip helps build up uniform films of the solids, and thus the individual particles may not serve as stress raisers in these areas.

The result would suggest that a solid lubricant may be applied to the rolling elements by a sliding process with reduced probability of experiencing rolling contact fatigue. In most rolling contact bearings this might be accomplished using a cage (retainer) that contains a solid lubricant as a component of the material. The cage is in pure sliding with the rolling elements and the cage locating surface of the race. Numerous powder-metal compositions are commercially available that contain graphite or molybdenum disulfide. An experimental material was formed by NACA using mixtures of silver, copper, and molybdenum disulfide (MoS_2). The commercial products of this type probably have much greater potential usefulness.

From a paper presented at the SAE Annual Meeting, Detroit, Mich., January 1958.

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Accelerated Testing Developments

By W. L. Pinner
Executive Staff Engineer
Houdaille Industries, Inc.
Detroit, Mich.

The electroplating of metals has progressed from an art to a science, with the most significant advances occurring in the past twenty-five to thirty years. This progress has encompassed such factors as (1) faster speed of plating with consequent economies in manufacturing cost and floor-space requirements; (2) the ability to deposit metals having a variety of properties, providing, as a function of the ultimate use, coatings of different degrees of luster, hardness, ductility, stress, thickness and so on; (3) increased knowledge of the relation of those properties to the function of the plate in providing wear resistance, abrasion resistance, corrosive protection of the basis metal on which it is plated and resistance to corrosion within itself.

Accelerated testing is the means by which product acceptance standards may be specified. It is also an indispensable tool for use in research and development in any program involving the evaluation of quality during experimental changes of procedure for almost any purpose.

Curiously enough, while tremendous strides have been made by the plating industry, it became recognized through careful experimentation, that up to the present time this industry has had at its disposal no accelerated test procedure capable of completely satisfying the requirements usually expected of any form of measuring device. Thus, the plating industry has been in a unique and, at the same time, unfortunate position in comparison with the majority of industries or processes. Con-

sidering the vast multitude of pieces, parts and assemblies resulting from industrial manufacturing operations, it is fairly difficult to think of one that cannot be measured or evaluated by some accurate device or method. Plating quality, on the other hand, has been reasonably accurately determined only by service tests and weather exposure, both of which, within themselves are variable and therefore, for certain purposes, inaccurate as well as time-consuming.

The plating industry has not blithely gone its way in disregard of this situation. With the limitations imposed upon it, exploratory work in scope ranging from pure research to full-scale industrial operation, has developed dependable information regarding the effect of many variables on plate quality. Notable among these may be mentioned the influence of the basis metal with respect to preplating operations performed on it. Added to the list, it is appropriate to mention the influence of purity and cleanliness of processing solutions together with the same properties of all components used in a plating process, such as anode materials, precleaning methods, electrical considerations and temperature control.

In the recent SAE publication, the individual phases of the development program were listed as follows:

1. The service exposure of specially designed and plated test parts in Detroit in the wintertime. The plating represented combinations of copper, nickel and chromium commonly used in the automotive industry. The behavior of the parts in service constituted a guide to the character and extent of corrosion as a function of type and thickness of plate.
2. The listing and study of all environmental conditions which caused corrosion of the test specimens.
3. The examination of approximately twenty-five different fundamental concepts in an effort to reproduce, in an accelerated manner, the types and extent of corrosion which occurred on the test specimens.
4. The selection of those procedures which bore promise followed by intensive work in their refinement.
5. The designation, in the form of a specification, of the exact procedures for carrying out the chosen test.
6. The calibration of the tests in terms of quality which is desired, compatible with that which industry is prepared to furnish.

Details of the test procedure and of the chemical mixture employed are to be found in committee reports. It is pertinent to mention that this test is specifically a controlled, accelerated procedure which duplicates service conditions causing corrosion of plated parts to occur in Detroit in the wintertime. The test, therefore, satisfies the objective of the program in this respect. It has been demonstrated that the test results of this procedure and of the acetic-acid modification of the salt-spray test, duplicates the type and extent of corrosion occurring in service. Both tests, within limitations imposed by other factors, appear to be reproducible.

The fundamental principles involved in the Corrodkote test represent the mechanism by which decorative plated coatings are attacked. The reader is reminded that corrosion occurs when a plated surface is maintained in a wetted condition in the presence of a corrosive environment. Such, for example, is the case of an automotive part coated with street slush from salted thoroughfares and then stored in a humid garage. The Corrodkote paste may be considered to be the street slush, of a known, controlled composition and of such a con-

centration of corrosive chemicals as to accelerate the attack on decorative plate. The noncondensing humidity may well represent the humid garage with the elevated temperature in the test also promoting an accelerated attack on the plated part.

Standardization and calibration of the two test procedures remain as unfinished jobs for the committee. It does appear that the industry now has important measuring devices available to it. In keeping with any research program, the validity of such a statement must be proved by extensive use of the test procedures by industry and by research workers.

From a paper presented at the SAE Annual Meeting, Detroit, Mich., January 1958.

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Standardization of the Inch

By A. V. Astin
Director
National Bureau of Standards

It is suggested that efforts be initiated to establish an international yard through negotiations with representatives of appropriate standardizing agencies of the major English-speaking nations. The international yard would be based on the international meter and defined as 0.9144 meter exactly. This, of course, would yield an international inch equal to 2.54 cms. The yard is suggested as the primary length unit for standardization because of its traditional position as the primary English dimensional standard. The initial mechanism for achieving such a standard might be through agreements between the various national standardizing laboratories. However, the National Bureau of Standards would not wish to initiate or participate in such an agreement until it had reasonable assurance that such a move would be consistent with the needs and desires of the majority of the groups within the United States who would be affected.

The primary purpose of accurately and reliably defined standards for physical measurement is to facilitate interchange: of goods in commerce, of components in industry where the interchangeability of parts is the heart of mass production, and of scientific and technical information among scientists and engineers.

From a talk presented at Bedford, Mass. to the Dimensional Standards & Metrology Div. of the American Ordnance Assn., Mills Bldg., Wash. 6, D. C.

Automatic Metering of Magnesium Opens Cold Chamber Die Casting Applications

By F. C. Bennett

Chief
Die Casting Section
Dow Chemical Co.
Midland, Mich.

The quality of the die castings produced by the metering process has been checked using visual, dimensional and radiographic methods of comparison, and a general improvement has been observed. This is undoubtedly due to the more uniform conditions of production.

The metering system is safer than manual lading because the operator stands behind the parting line during the cycle. He can regulate the thickness of the cast "biscuit" at the end of the shot piston to minimize the bursting hazard as the die opens. Parting line guards can be used if desired without interfering with the metering cycle. Metal losses are comparable to those reported with good magnesium hot-chamber practice.

Cold-chamber metering offers flexibility to the plant where magnesium and aluminum must be processed on the same machines. The feed unit can be moved back to permit hand ladling of aluminum or it can be temporarily replaced by one of the aluminum ladling devices using similar electrical circuitry.

It is well suited to large parts where hand ladling is very difficult and might otherwise require two men, e.g., transmission housings and engine blocks. Thin walled parts with appreciable area would be easier and more economical to produce with this equipment due to the improved control of casting variables, e.g., industrial tools and office machinery. Special alloys should prove easier to process for aircraft and missile applications.

An automatic metering system for supplying molten magnesium alloy to cold-chamber die-casting machines has demonstrated production rates equal to those achieved by hot chamber zinc or magnesium machines without some of their limitations. The process is simple in principle, flexible in operation, continuous, safe, easy to run and produces good castings.

From a paper presented at the 13th Annual Convention, The Magnesium Assn., 122 E. 42nd St., New York 17, N.Y.

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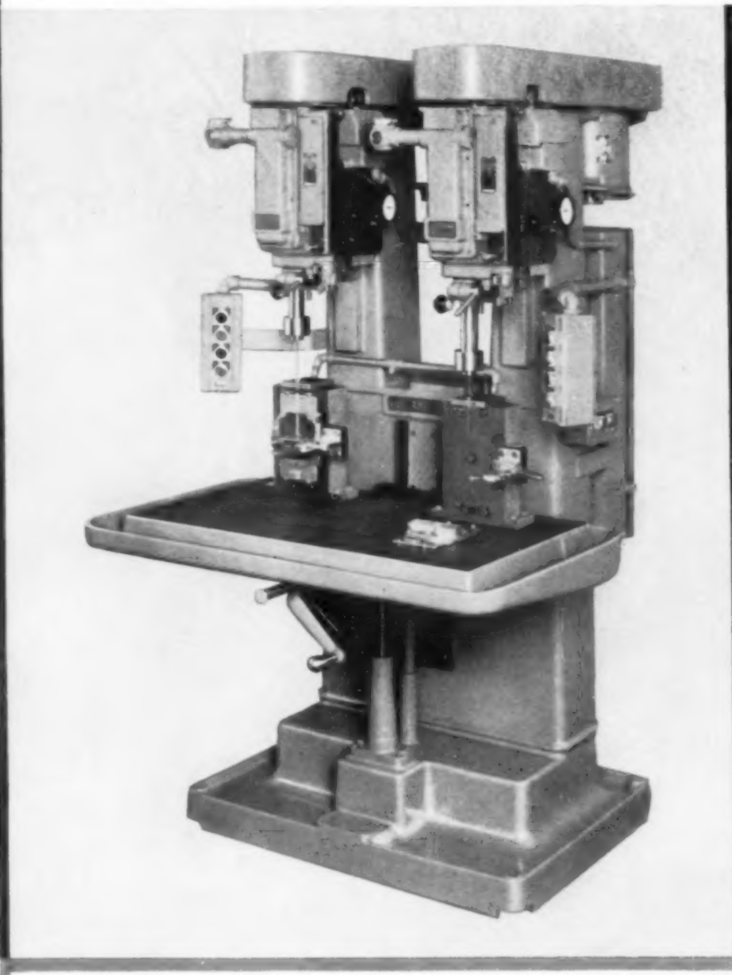

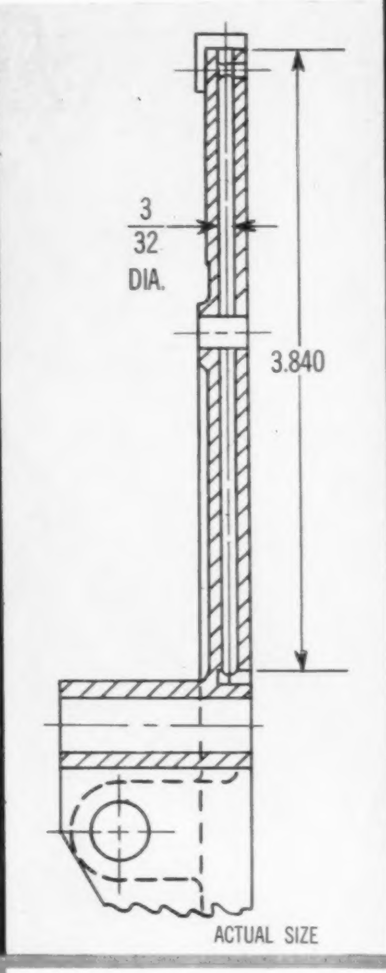

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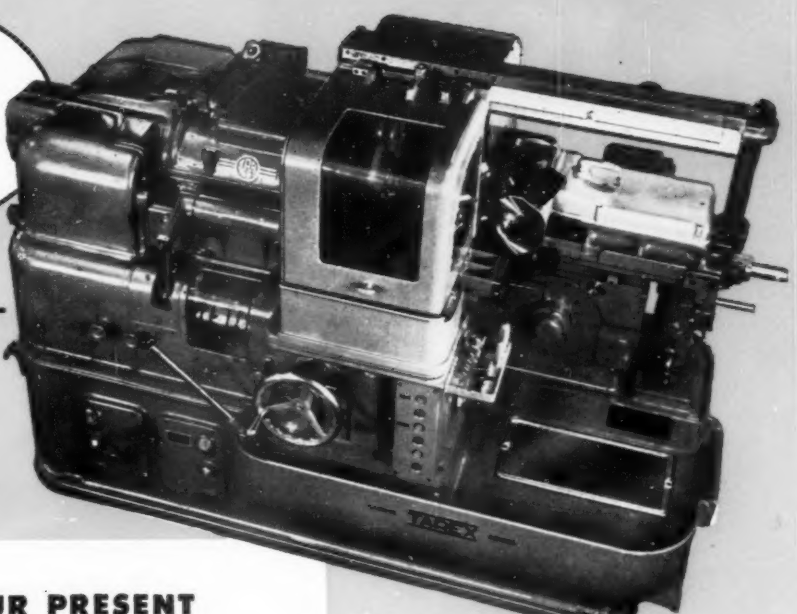

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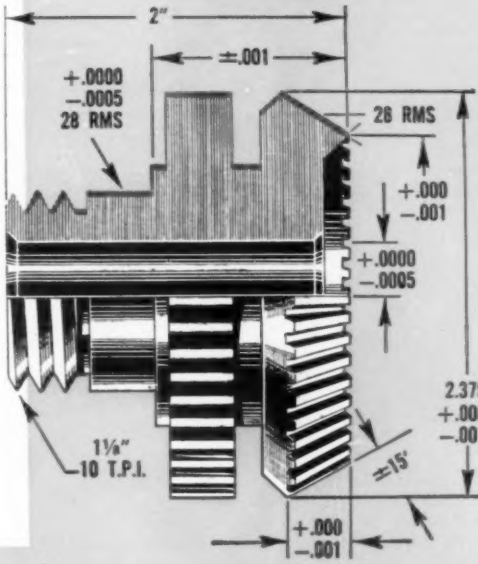

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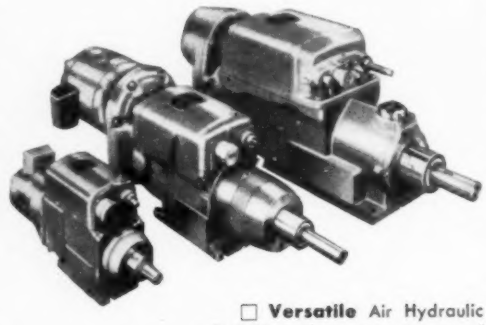

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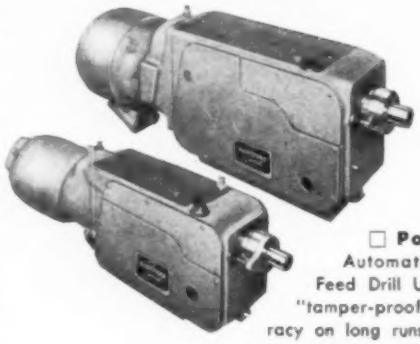

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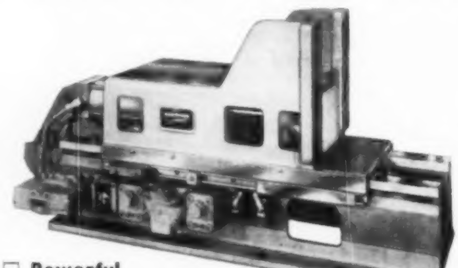

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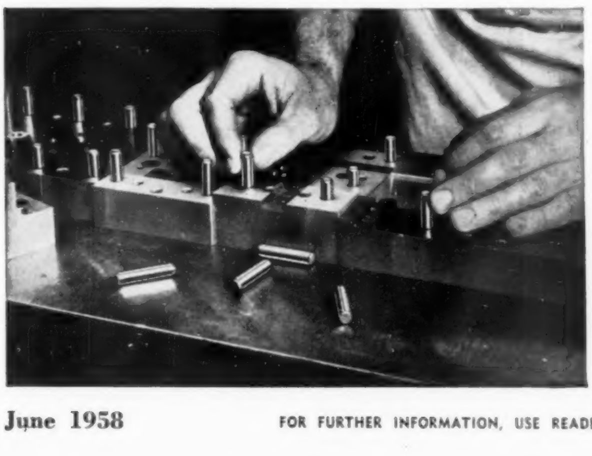

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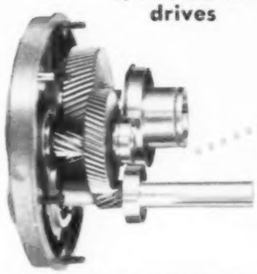

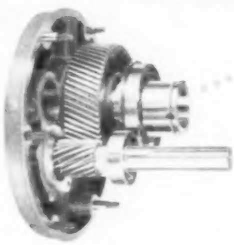

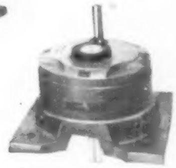

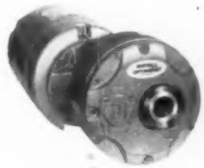

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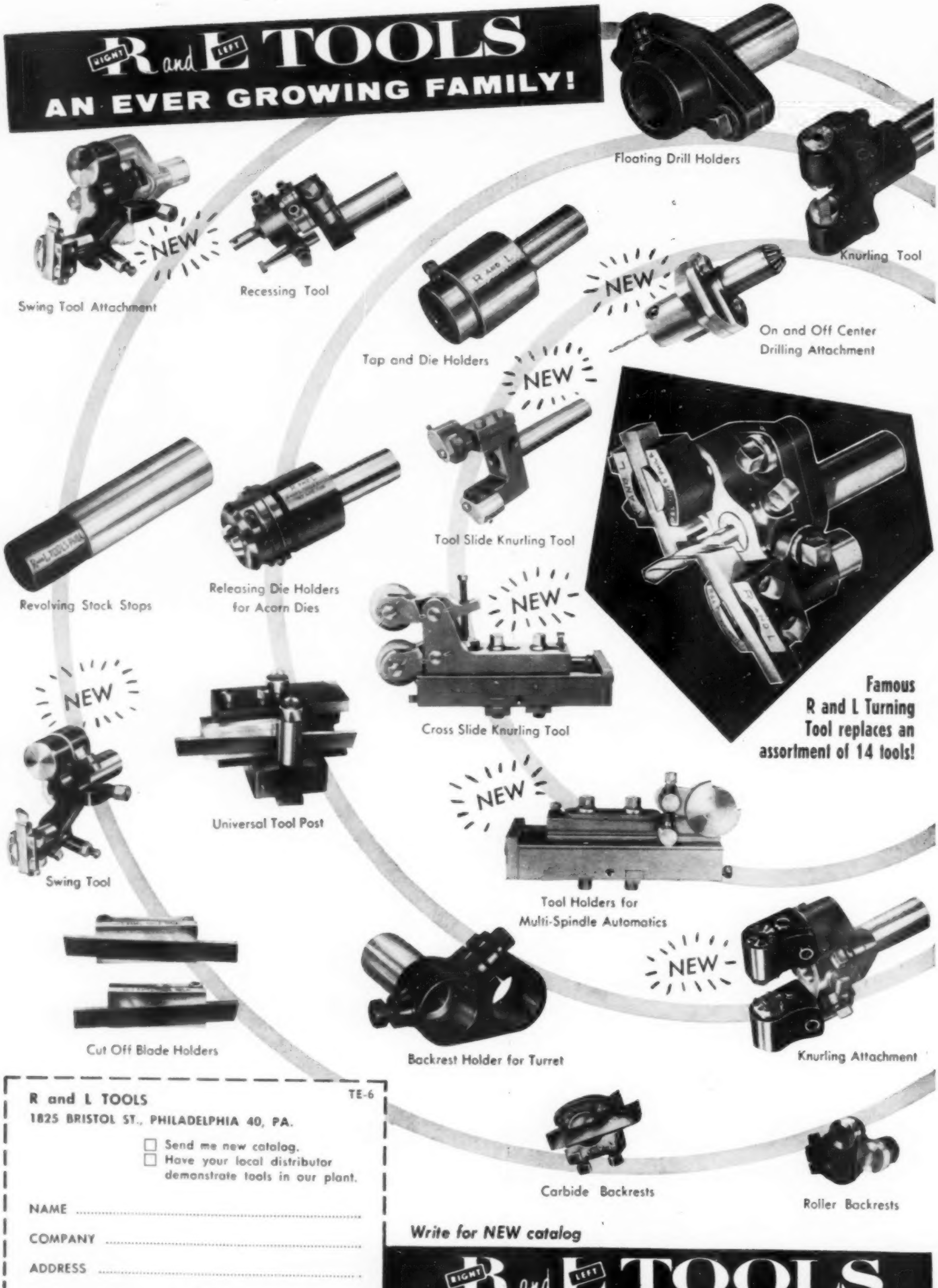

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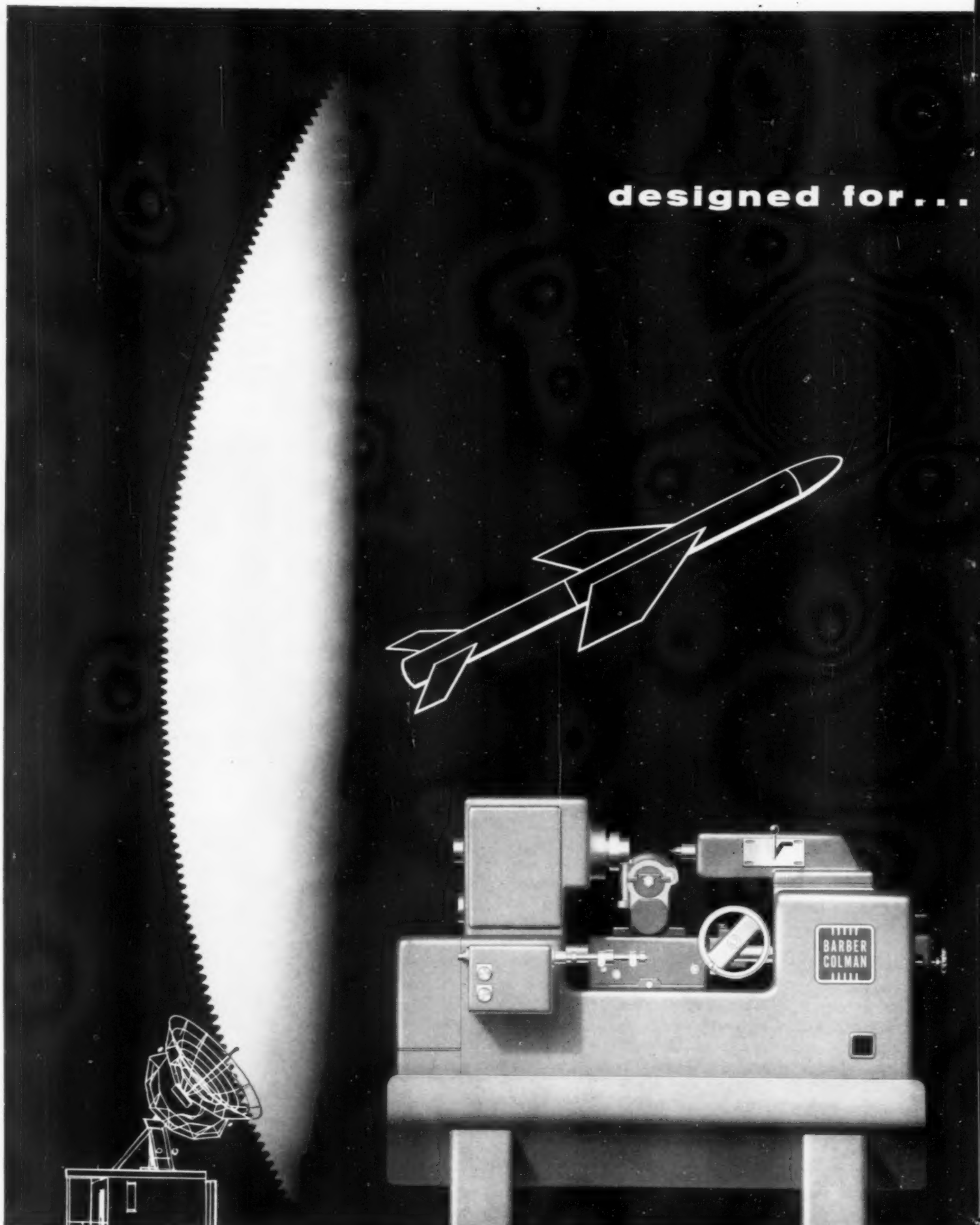
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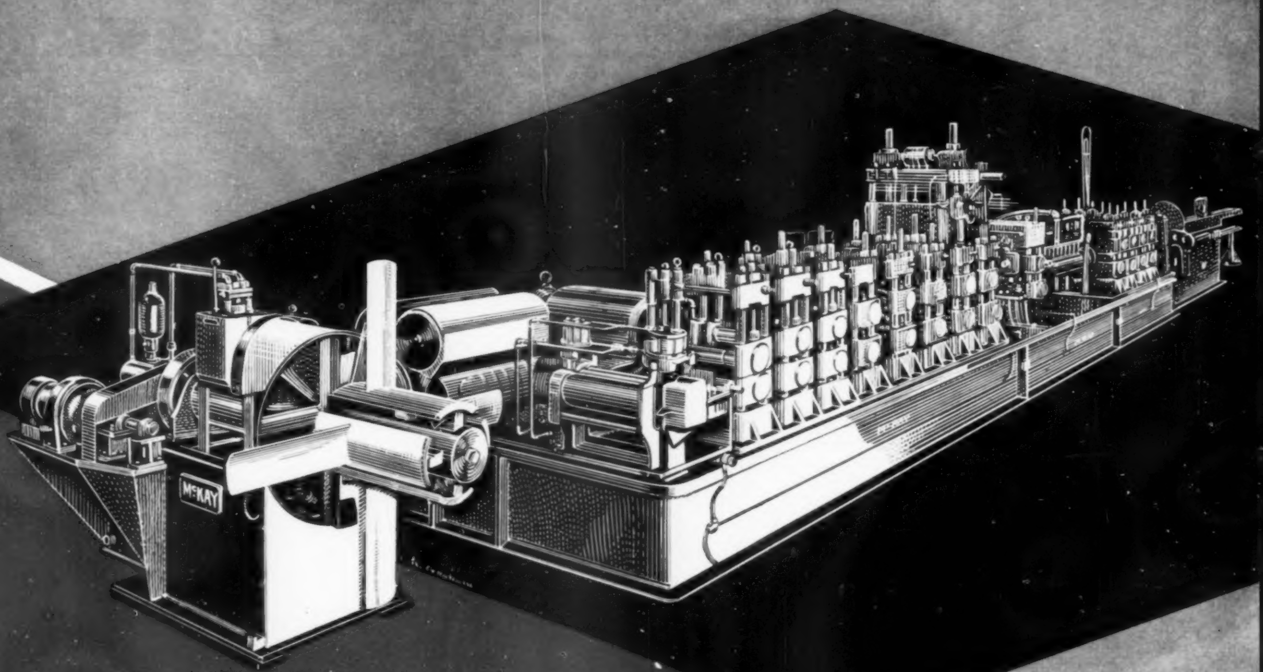

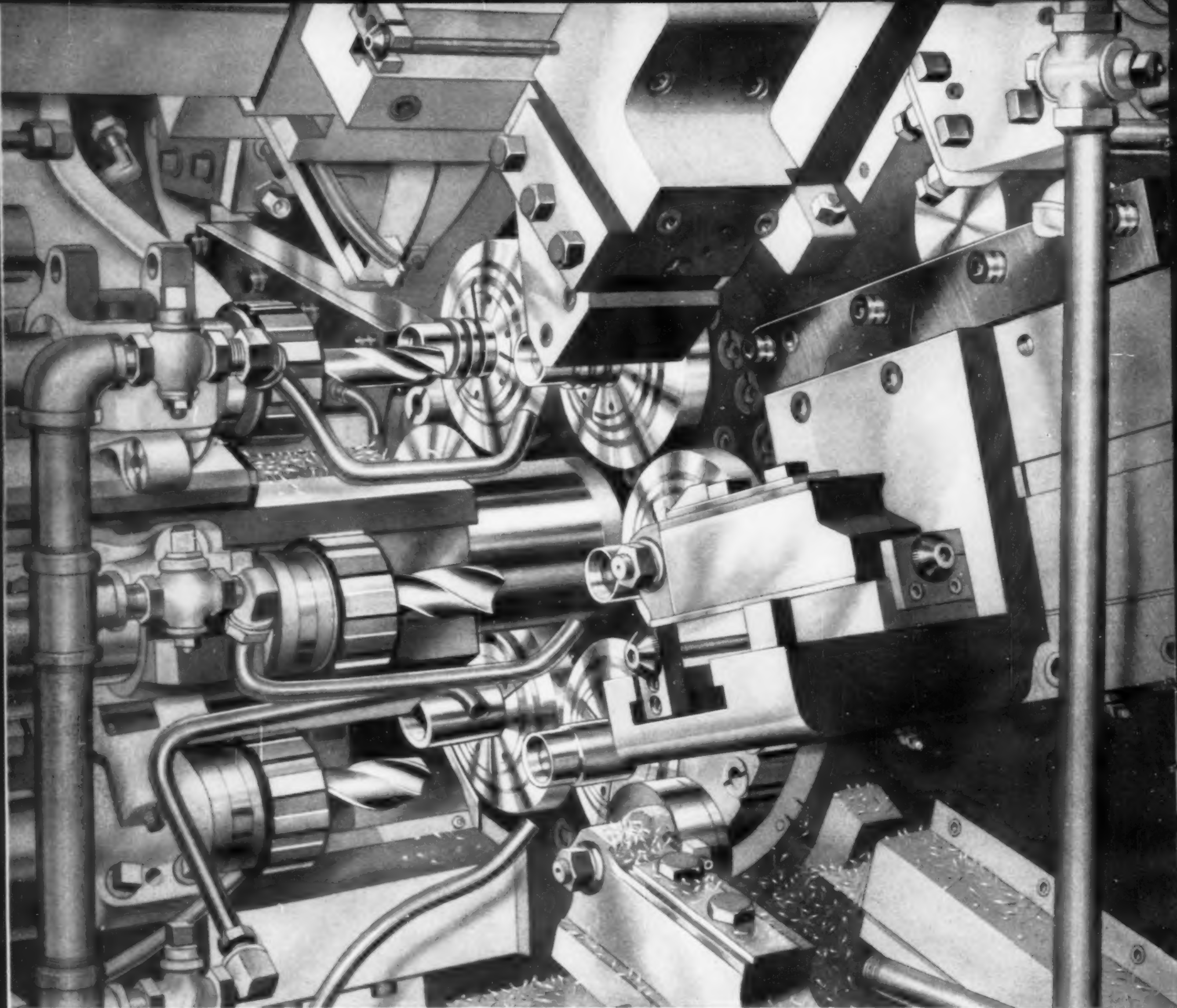

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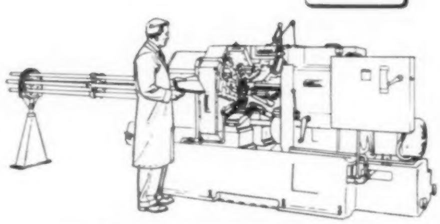

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Heller "Job Tempered" Tools

Gardner-Denver (Keller) 000RSD and 12A-2 screw drivers with cushion clutch, magnetic bit holder and Phillips insert bit assembling dual headlights for 1958 cars.

These Air-Operated Screw Drivers Are Paying for Themselves

If you drive only 400 screws a day, a Keller air-operated screw driver, such as those shown above, will pay for itself in six months. These lightweight air tools are easier on their users . . . help them keep pace with fast-moving assembly-line work.

Despite their high load factor, Keller pneumatic screw drivers run cool always. They have the right combination of torque, adjustable clutch and magnetic holding of screws for fast, efficient driving. They are the modern way to reduce assembly-line time and costs.

Send for the 40-page booklet. This Gardner-Denver booklet gives complete information about Keller screw drivers and nut setters, as well as other Keller air tools and accessories. A copy is yours for the asking.

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ELECTRO-AUTOSIZER

an attachment which

Automates any of your present machine tools... by gauging the piece in progress

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GRINDERS

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your key to precision automation

The remarkable new Electro-Autosizer will feed back I.D. data from a finished piece to machine controls so that the mating workpiece being ground fits exactly....*in one chucking.*

Use it also for *automating post process inspection.*

For large or small lot jobs, with loose or extra fine tolerances, the Electro-Autosizer attachment is your Economical *key to automation.*

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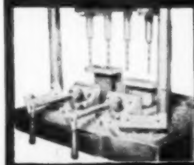

TWO SPEED VISES HANDLE DIFFERENT JOBS AT THE SAME TIME.

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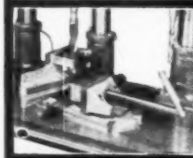

NEW LARGER MODELS PROVIDE SAME SPEED VISE ECONOMY FOR WORK ON HEAVIER MACHINES.

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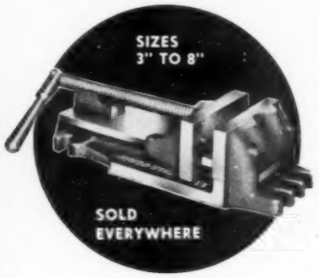

Save 50% on tooling costs with simple, inexpensive jigs in a SPEED VISE. Double your drilling capacity! The cost of the SPEED VISE is very low.

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CARDINAL MACHINE CO.

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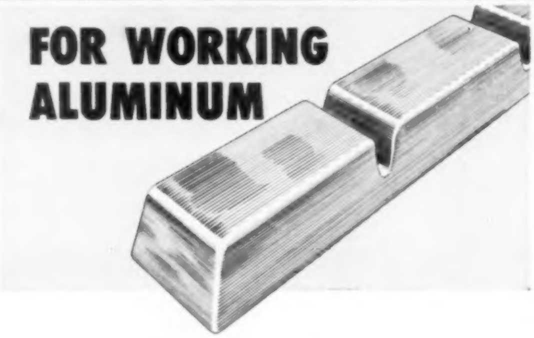

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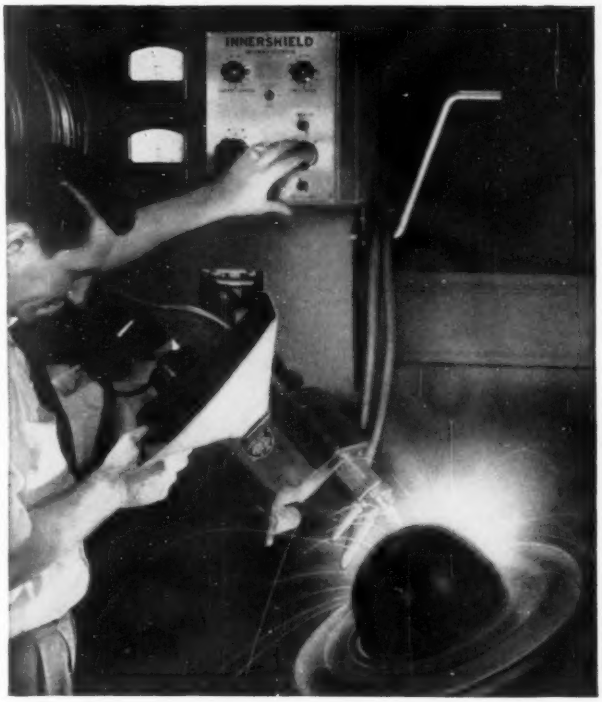
Weldynamics

ARC WELDING AT WORK CUTTING COSTS



New Shielded Arc Automatic Welding

Speeds to 180 ipm!

on 14 gage steel

No Flux or Gas

with

INNERSHIELD

Innershield—an ultra-high speed automatic welding process. No loose flux or gas! Shielding material is in the wire. Produces welds of shielded arc quality consistently at speeds as high as 180 inches per minute. For steels ranging from light gage to ¼" thick.

If you do high speed, production welding, learn how Innershield will speed up your operation and cut costs. Write for Bulletin 5301.1.

The World's Largest Manufacturer of Arc Welding Equipment

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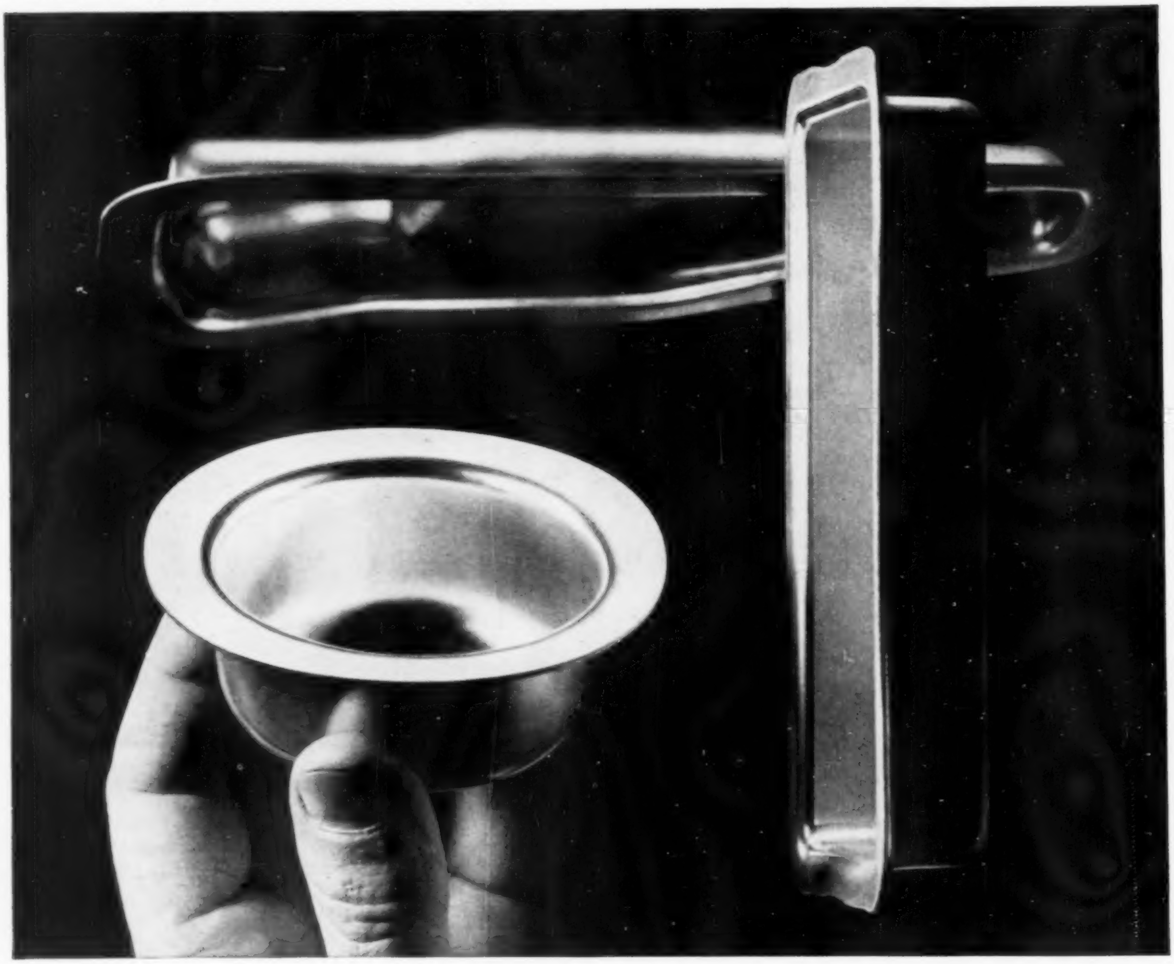
THE LINCOLN ELECTRIC COMPANY • DEPT. 5021 • CLEVELAND 17, OHIO



Now . . . stamp metal parts with resin dies!

New 3M Brand compound saves 50% to 90% in tooling costs

Now, you can actually stamp metal parts, such as those above, with resin dies! From Minnesota Mining and Manufacturing Company comes 3M Brand Tooling Compound 113.

It's a new, two-part tooling compound that combines catalyst-treated steel powder and liquid resin to form low-cost dies that have exceptional impact strength and can operate in presses up to 85 tons. What's more, dies made of Tooling Compound 113 perform at the same production rates and efficiency as do dies made of steel.

In addition, new Tooling Compound 113 eliminates the bugaboos of weighing, mixing, pot-life and toxicity common to conventional tooling compounds. Preforms are fabricated from the treated steel powder; then placed in a pan containing liquid resin for impregnation and curing.

Simpler handling, faster drying and curing achieved with Tooling Compound 113 saves time and materials to cut tooling costs by 50% to 90%, compared to those of ordinary methods.

3M Brand Tooling Compound 113 is ideal for short runs—in the thousands—for punch-and-die operations. Investigate these profit-saving benefits now. For full data, write: *3M Company, Dept. WS 38, St. Paul 6, Minnesota.*

Hastings Chemical Division • Chemical Products Group

MINNESOTA MINING AND MANUFACTURING COMPANY

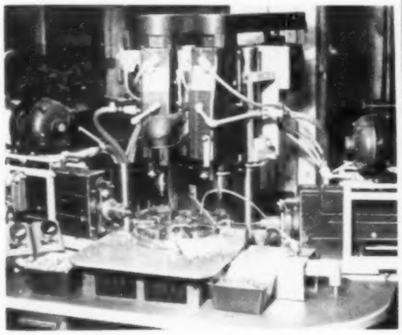
. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY CHEMICALS


LEADERSHIP at work

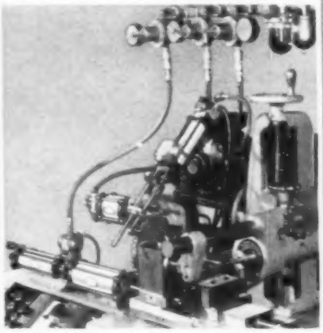
The Bellows AIR MOTOR

can help you make cost savings like these...



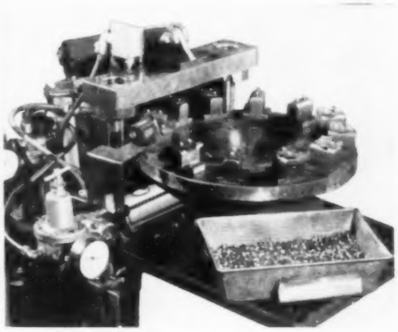
COSTS CUT FROM $15.30 TO $1.50 PER 1000

Five Bellows Work Units combine to drill 4 holes in a brass fishing reel pawl. Built in the company tool room this special machine paid for itself very quickly, increasing output from 100 pcs. to 1600 pcs. hourly.



MILLING OPERATION DONE 6-TIMES FASTER

Three Bellows Air Motors and one Hydro-Check, added to a standard milling machine, cut milling time from 3 minutes per part to 30 seconds, in milling splines in welding torch tips.



PAID FOR ITSELF IN 90 DAYS

Chain-saw cutting teeth are press-assembled on this special machine built around a Bellows Air Motor and a Rotary Feed Table. The company's president commented. "Our savings in the first 90 days covered any expense we went to to make the change."

Here are three actual cases of large cost reductions made in metal working operations. In each case savings have been made by using one or more Bellows Air Motors . . . to replace slow, manual methods, or to combine separate, related operations into one efficient, economical process.

Such conversions are inexpensive and amazingly easy. For the Bellows Air Motor is a unique and different air cylinder. It is a power unit complete in itself — with all controls built-in. Advance and retract speeds are independently adjustable. Built-in 4-way valves, in a wide choice of electrical, pneumatic, or manual controls, provide the type of control needed for each job. Only one air connection is required, and that can be made with flexible hose. Bellows Air Motors are easily interlocked for automatic sequencing of work movements.

With these facts in mind, take a new look at your own shop. Wherever you see an operator's hand or foot moving a crank, wheel, lever, or pedal back and forth . . . back and forth, you see a high-cost operation. In nine out of ten such cases a Bellows Air Motor can do the job faster, better and far cheaper.

The Bellows Co.
DIVISION INTERNATIONAL BASIC ECONOMY CORPORATION
AKRON 9, OHIO

WRITE TODAY FOR BULLETIN BM-25
THE BELLOWS AIR MOTOR.
DEPT. TE-658

1307A-2

drill • ream • chamfer spot-face • center • deburr

do all these operations

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Catalog No. 26-062
½ hp., 208/220 V., 50/60 cy. 3 phase, totally enclosed motor 1440/1725 rpm

***F.O.B. Racine**

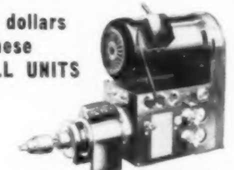
AUTOMATIC DRILL UNIT

This unit is a quality engineered, compact driving head for a wide variety of machining. It is fully automatic with built-in basic electrical and pneumatic controls. It is ideal for long production runs or multiple set-ups where frequent changeovers are not necessary.

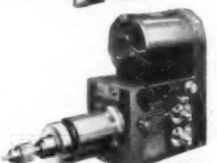
It is a powerful, versatile, all-purpose unit that lets you use it where you need it—on drill presses, fixtured set-ups, bench mounted; or added to special-purpose building-block production machines, transfer stations and other automatic machining systems. Keeps right on working on set-up after set-up!

This special Dumore nose mounting bracket is your key to all-purpose machining—*anywhere*. It permits fast, easy mounting in any position, angle or direction in single set-ups, or multiple machining operations in sequence. Changeovers, when necessary, are made quickly, speedily. Return to original set-up is equally fast!

You can save hundreds of dollars in first cost alone with these DUMORE AUTOMATIC DRILL UNITS



Series 28
"Drill-N-Tap" Unit — 2 tools in 1 at the cost of only one. Drills or taps at the flip of a switch. Tap fits into chuck, no extra head required. Reversing motor removes tap, eliminates costly clutches. 265 to 4900 rpm. For long or short runs.



Series 24
Fully automatic with all controls built-in. Preselected speeds, feeds, depths. Ideal for varying runs and frequent changeovers.

Series 20
Automatic Drill Heads for high production drilling of small parts. Stops drill breakage. Built-in controls. No. 80 to 5/32" capacity.

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Tool Steel Topics

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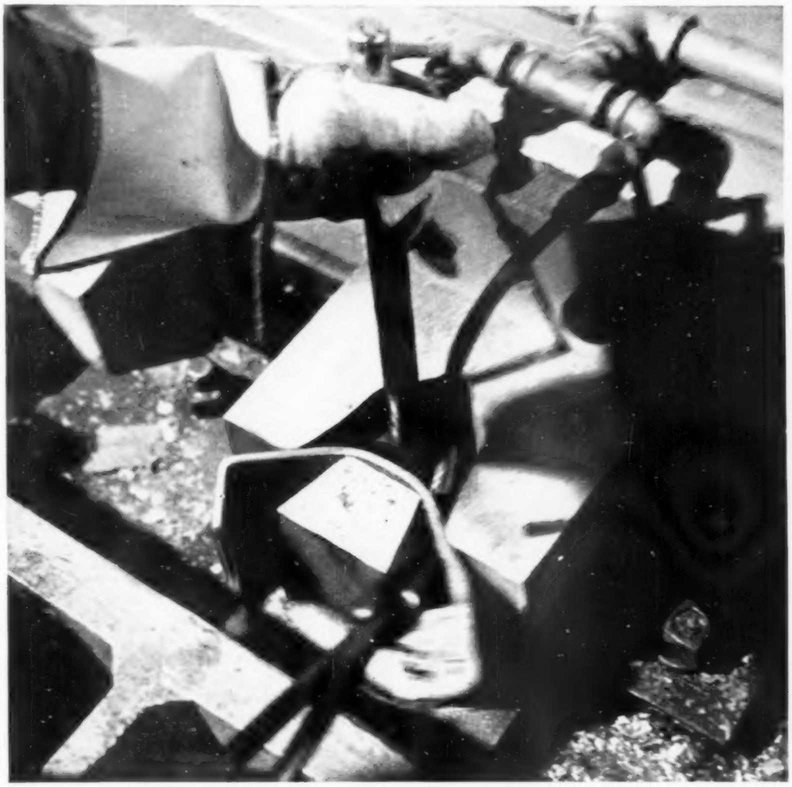


Highway Guard Rail Brackets Formed Red-Hot with Cromo-W

The product is a steel offset bracket, ¼ in. thick. It's used for fastening wire rope to highway guard rail posts. The bracket is formed red-hot, with a two-stage die of Bethlehem Cromo-W tool steel. Between 90,000 and 100,000 pieces are produced before redressing becomes necessary.

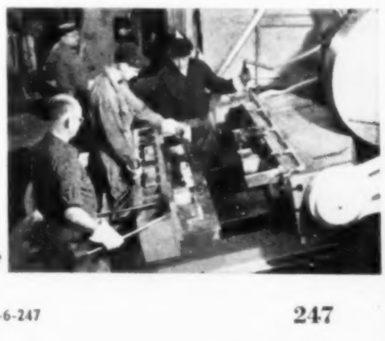
Cromo-W has a 5 pct chromium content and is one of our most popular general-purpose tool steels for a variety of hot-work applications. It offers good red-hardness and high shock-resistance. It also has good resistance to heat checking when cooled drastically during high-temperature operations, and is easy to machine and heat-treat.

Cromo-W is an ideal grade of tool steel for such diversified uses as die casting dies, bolt-gripper and bolt-header dies, trimmer dies, punches, and hot shear blades. In fact, it's a grade you can count on for long service in virtually any manufacturing operation involving severe shock and temperature change.

Typical Analysis

Carbon 0.35	Tungsten 1.55
Silicon 1.05	Molybdenum 1.65
Chromium 5.15	

In addition to Cromo-W, Bethlehem offers Cromo-WV and Cromo-High V for die casting and extrusion work. See your Bethlehem tool steel distributor for full details on these fine hot-work grades.



General view of the forming operation. Cromo-W is ideal for this hot-work application because of its good red-hardness and high shock-resistance.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Machining is a Tearing Operation

Close examination of the surface of a machined part, or chips machined from it, indicates the presence of countless minute tears. Generally, the tears can be seen most readily on parts machined at low speeds, with heavy feed and depth of cut. However, they are also present in all machined surfaces, even though not readily visible. The depth of surface tears on smooth machined tools and dies may be approximately one thousandth of an inch, or less. For this reason, the presence of the tears and their possible effects are often overlooked.

Most tools are heat treated after machining. Then they are ground all over to produce the exact dimensions, and to remove scale or decarburization resulting from the hardening operation. This procedure automatically removes tears in the surface previously produced during machining. However, many tools are ground only on certain portions, with the balance of the tool surfaces containing the remains of the machining tears, plus heat treatment scale and decarburization. This condition occurs often when you grind only the actual working surfaces which make contact with the parts. Tools produced by this method are more susceptible to failure in service because of stress concentration produced by the sharp change of section in the tears. This is particularly true of tools subjected to a large number of stress cycles in service, such as pneumatic tools.

Grinding all previously machined surfaces of tools after hardening is an operation which helps improve production from the tools. Grinding before hardening will also be effective, should grinding after hardening be inconvenient.

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GREAT NAMES IN INDUSTRY produce MORE for LESS with PEECO

The story at PEECO can best be paraphrased — "... known by the company they keep . . ." The long list of companies that now 'produce more', because PEECO vibratory feeders are engineered to work, reads like America's industrial "Who's Who". PEECO'S technical knowledge in parts feeding can help you schedule one or more parts at a given rendezvous at a predetermined rate per hour and oriented to the exact position desired. Obviously this generates great savings. Let PEECO sales engineers help you 'produce more'. Send for new literature on the latest feeding technique.

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WITH NEW ELECTRICALLY CONTROLLED AIR CLUTCH

- "Plug-in" foot and hand controls.
- Single stroke, continuous and jog selector.
- Low air consumption.
- Large die area.
- Roller bearing flywheel.
- Bronze main and crank bearings.

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SPINDLE SPEEDS 150 and 250 RPM Other Spindle Speed Pulleys Available

MODEL B943 MOTOR DRIVEN WORK HEAD

No. 11 B & S Tapered Spindle Standard Equipment. No. 12 B & S or No. 5 Morse Available at Slight Extra Cost.

Clip ad to your letterhead and send for Literature

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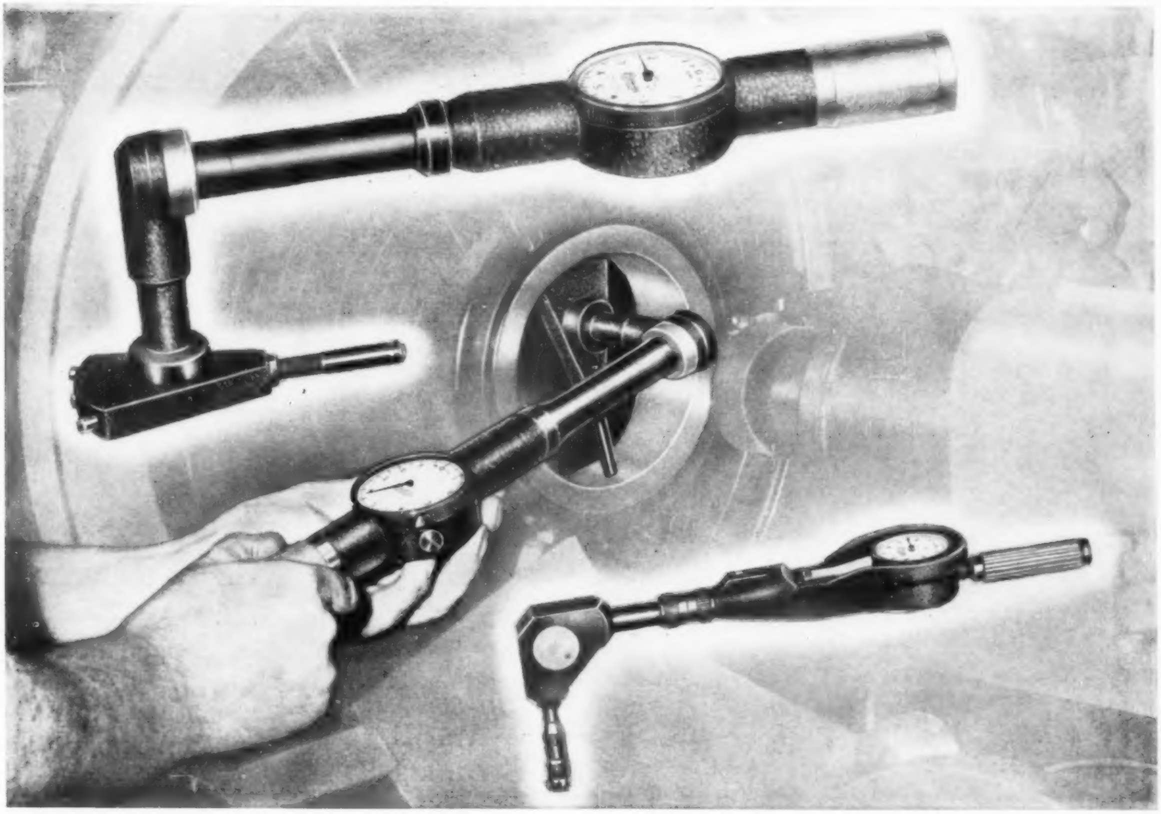

NEW...RIGHT ANGLE Dial Bore Gages for "Hard-to-Get-at" Openings

THIS *new* type dial bore gage *by* STANDARD speeds gaging where space is limited. Designed for use on work in *jig borers, internal grinders* and *horizontal boring mills* without disturbing machine set-up or need for excessive backing off. Also for parts inspection where space is restricted.

Gage head and dial unit can be turned in any direction, adding to the *convenience* and *safety* features which make this new gage a real "knuckle saver" by keeping hands away from sharp tools and turning wheels.

A set for economical tool room and job shop use consists of a single dial unit with two interchangeable heads covering a range from 3/8" to 1". Individual gages in six sizes cover a range from 3/8" to 6 1/8". Ask the *Man from Standard* for demonstration.

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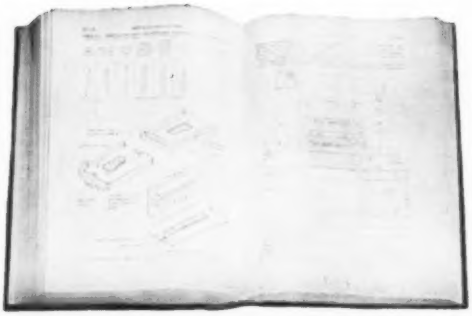
A COMPLETE LINE OF GAGES . . . INDICATING, FIXED AND ADJUSTABLE TYPES



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PIONEER IN POWDER AND MOLTEN METALLURGY

Your assurance of results . . .

your guarantee of genuine Firthite in your blue-print tools

When you specify Firthite sintered carbide for your important blue-print tools, you count on top quality and money-saving performance. Now, Firth Sterling, in cooperation with leading toolmakers, offers a guarantee of quality unmatched in the industry.

This exclusive new service is designed to help you get maximum efficiency in your metal removal applications. It is typical of the progressive thinking that has characterized Firth Sterling during more than 68 years of metallurgical pioneering.

CERTIFICATION: To assure you that the exact grade of Firthite you specify goes into the cutting tools you buy, the bright, new label shown above will appear on the shank of each tool. It certifies a product engineered and quality controlled from ore to the finished tool—tools that cut faster, stay sharp longer and reduce downtime for regrinding. Firth Sterling and most leading toolmakers have agreed to apply this label *only* on tools using genuine Firthite.

* * * *

Insist on the Firthite label when you order blue-print tools—your certification of grade and quality. For further information on Firthite sintered carbide, or help with *any* metallurgical problem write: Firth Sterling, Inc., Dept. 10F, 3113 Forbes St., Pittsburgh 30, Pa. Warehouses and offices in principal cities.

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G. ALLAN MacNAMARA

Portrait by Fabian Bachrach

"IT'S AGAIN FASHIONABLE TO BE THRIFTY—and 69% of our Soo Line employees are saving regularly through the Payroll Savings Plan"

"It's again fashionable to be thrifty, and it is reassuring to note that 69% of our employees on the Soo Line are making regular purchases of U. S. Savings Bonds. Inflation is a complex thing, but here is a simple, direct step every one of us can take to help control the rising price spiral. Our recent company-wide campaign has proved that employees *want to* and *will* practice thrift by buying U. S. Savings Bonds."

G. ALLAN MacNAMARA, *President, Soo Line Railroad*

Individual savings are the bedrock of a sound economy. Today there are more Payroll savers than ever before in peacetime. If employee participation in *your* Payroll Savings Plan is less than 50% . . . or if *your* employees do not now have the opportunity to build for their future through the systematic purchase of U. S. Savings Bonds, your State Director will welcome an opportunity to help. His experience is yours, in setting up a Payroll Savings Plan or in building up enrollment in one already existing. Look up your State Director in the phone book. Or write: Savings Bonds Division, U. S. Treasury Dept., Washington, D. C.

American Society of Tool Engineers
10700 Puritan Avenue   Detroit 38, Michigan

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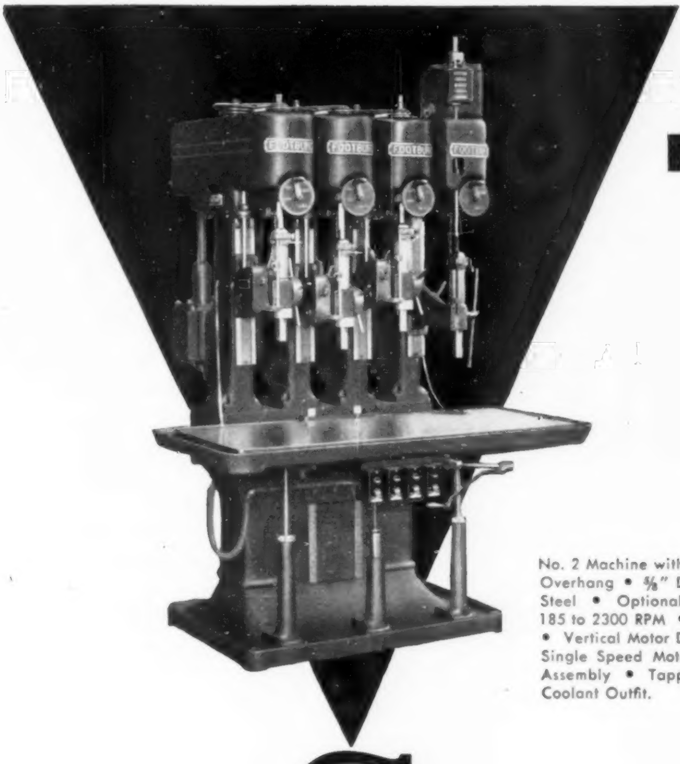
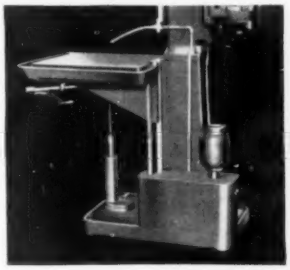
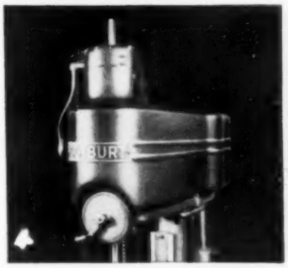


FOOTBURT





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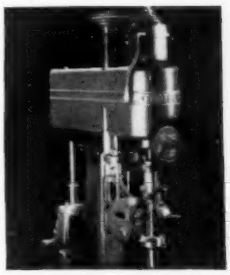

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a Fine Grained, Silicon Killed

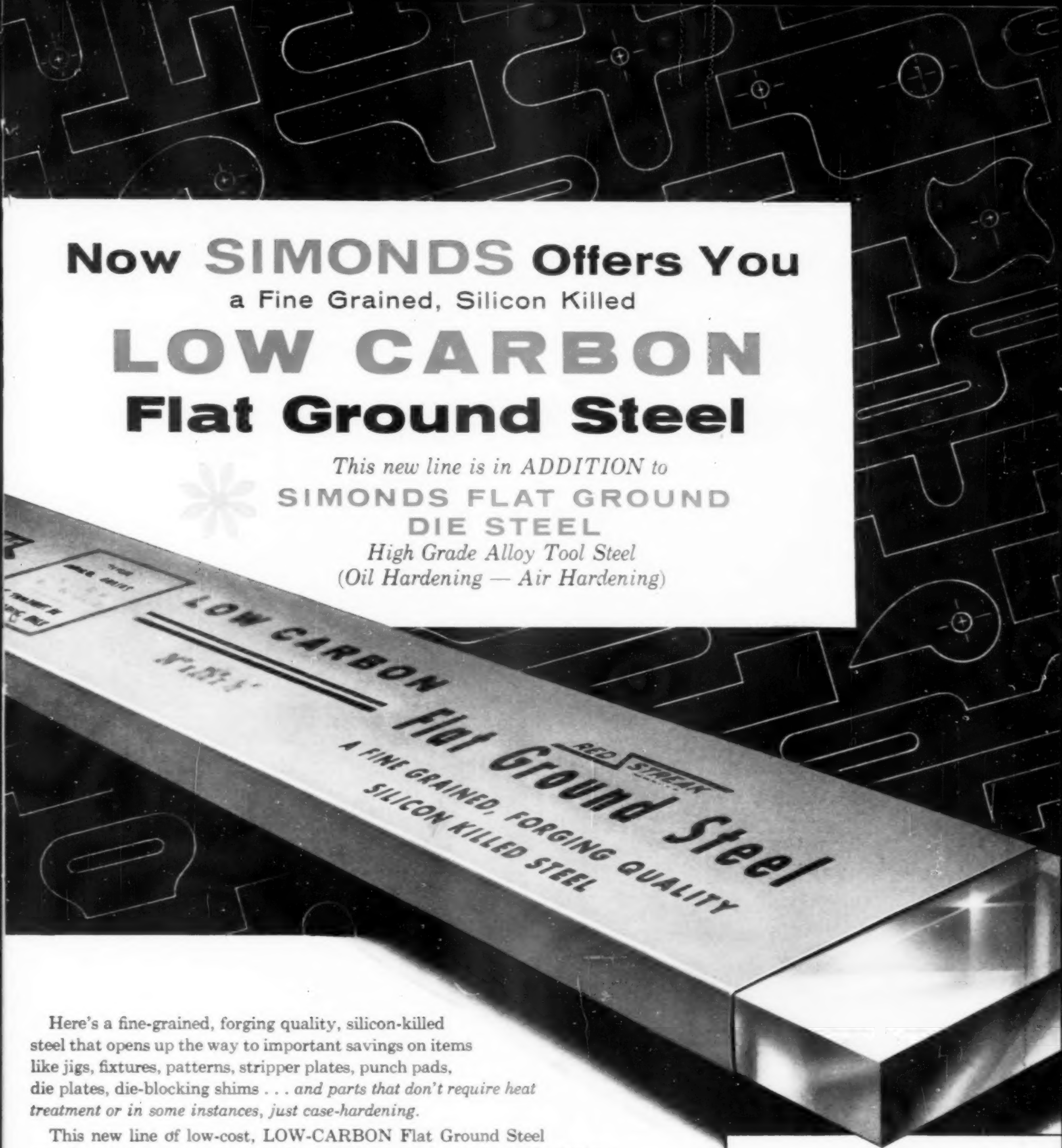
LOW CARBON

Flat Ground Steel

This new line is in ADDITION to

SIMONDS FLAT GROUND DIE STEEL

High Grade Alloy Tool Steel
(Oil Hardening — Air Hardening)



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Si. .20	Phos. & Sul. .04

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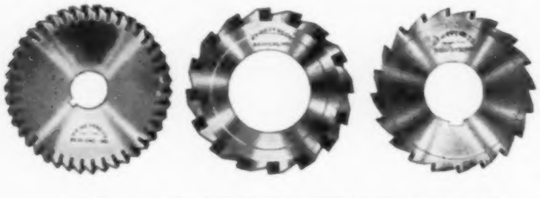

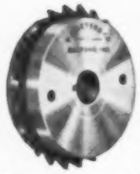

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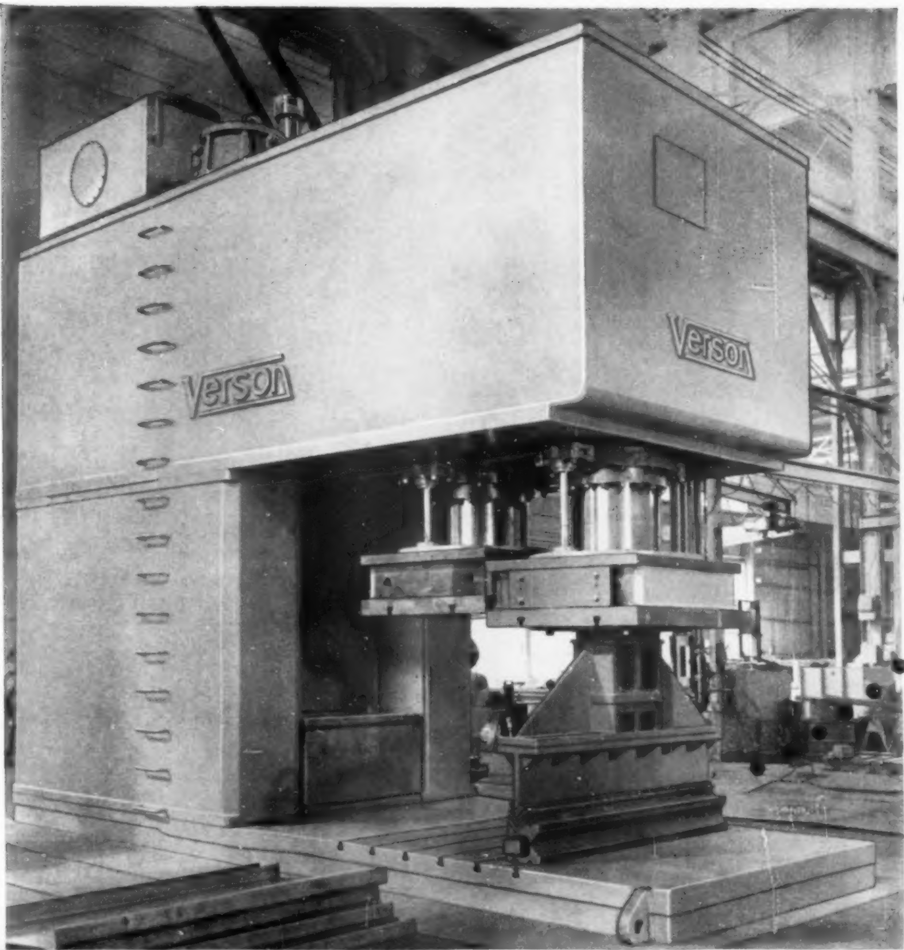
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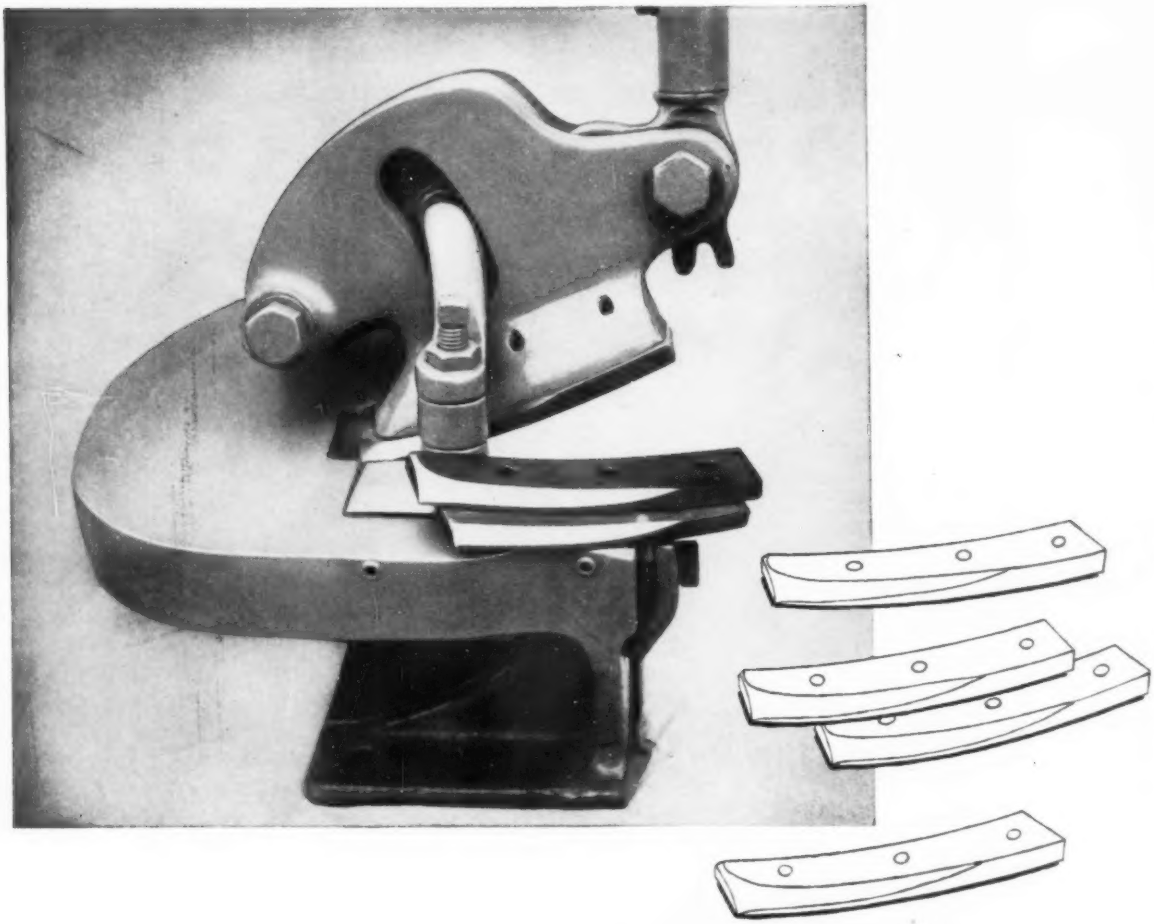

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with A-L HURON DIE STEEL

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ADDRESS DEPT. TE-6

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WBW 6366

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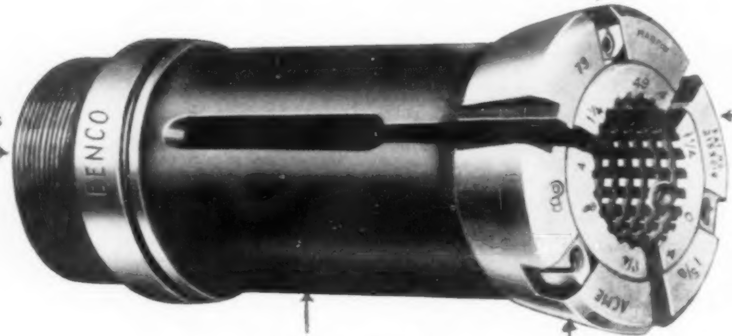
BENCO MASTER COLLETS

adds up to longer and better service life

Patented locking device prevents pads loosening from any cause.

Accurate threads with 175,000 pounds per square inch tensile strength.



Front loading pads may be changed without removing collet from spindle . . . saves set-up time.

Properly tempered alloy steel provides suitable spring action.

Hardened tapered bearing surface cam-ground to operate faster and grip tighter

Besides working better and lasting longer, these Benco "Martin" Master Collets permit you to work to closer tolerances. Their accuracy is guaranteed to be less than .001 run-out per inch of bar extension from the collet face.

Even with all their features Benco Collets cost you no more than just ordinary collets. You get maximum performance . . . you save time and money by using them on all your automatics.

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Cleveland, Ohio

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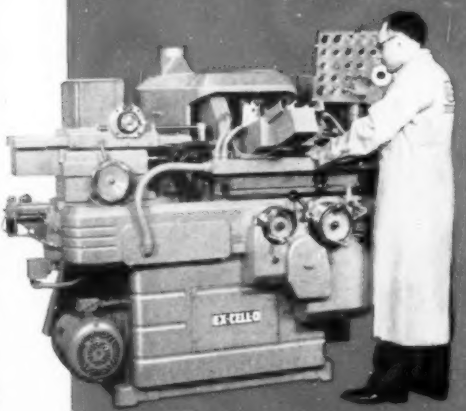
Automatically!

These automobile steering gear ball-race screws are rough-ground from the solid on an Ex-Cell-O Thread Grinder. This operation was formerly done by thread hobbing or milling. The screws then go into the machine illustrated, an Ex-Cell-O Style 33 Thread Grinder, equipped for automation. It self-loads, locates, finish-grinds, and ejects steering gear screws. What's more, when desired, the wheel can be automatically dressed after completing a predetermined production. It increases hourly per-unit output over manually operated machines while actually decreasing the number of rejects. A double saving.

Ex-Cell-O Precision Thread Grinders come in a wide range of models—some best suited for toolrooms and short runs, others designed for fully automatic, high volume output. In all, there are five models adaptable to any production requirement.

Why not find out today how these Ex-Cell-O Precision Thread Grinders may be able to reduce your per-unit costs? For full information, just call your nearby Ex-Cell-O Representative.



Ex-Cell-O Style 33 Thread Grinder equipped to automatically grind steering gear ball-race screws.

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57-73

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